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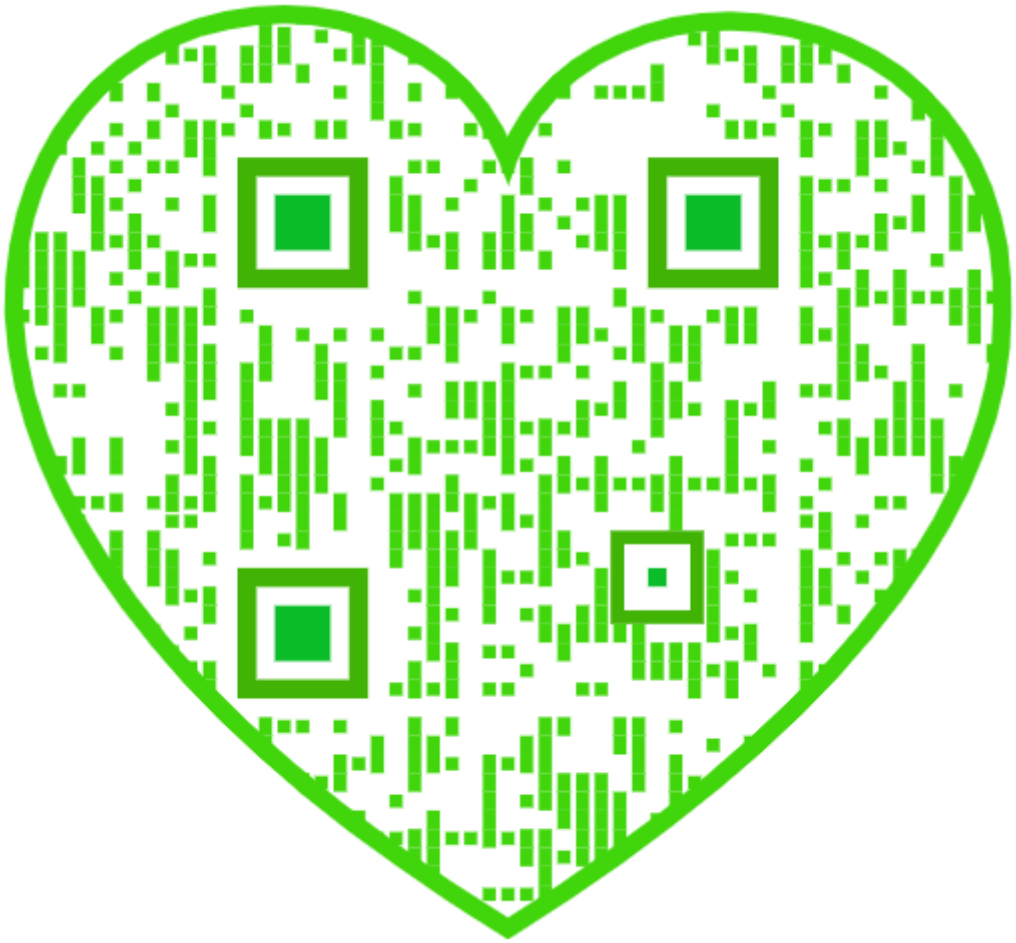

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THE AMERICAN TEXT-BOOK OF OBSTETRICS

FOR PRACTITIONERS AND STUDENTS

BY

JAMES C. CAMERON, M.D., EDWARD P. DAVIS, M.D. ROBERT L. DICKINSON, M.D., HENRY J. GARRIGUES, M.D., BARTON COOKE HIRST, M.D., CHARLES JEWETT, M.D., HOWARD A. KELLY, M.D., RICHARD C. NORRIS, M.D., CHAUNCEY D. PALMER, M.D., GEORGE A. PIERSOL, M.D., EDWARD REYNOLDS, M.D., HENRY SCHWARZ, M.D., J. CLARENCE WEBSTER, M.D.

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WITH NEARLY 900 ILLUSTRATIONS

Second Edition, Revised

VOL. II.

W. B. SAUNDERS & COMPANY

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PREFACE TO THE SECOND EDITION.

Since the appearance of the first edition of this work many important advances have been made in the science and art of obstetrics. The results of bacteriologic and of chemicobiologic research as applied to the pathology of midwifery; the wider range of surgery in treating many of the complications of pregnancy, labor, and the puerperal period—embrace new problems in obstetrics, some of which have found their final place in obstetric practice. It seems proper, therefore, to offer to the profession a thorough revision of this text-book. Some of the chapters have been rewritten, others have been thoroughly revised. A number of the illustrations that appeared in the first edition have been replaced by others of greater artistic excellence, and several additional illustrations have been added.

It will be noticed that Dr. J. Clarence Webster has been added to the list of contributors; while it is with deep regret that the editor recalls the death of Doctors Theophilus Parvin, James H. Etheridge, and Charles Warrington Earle. The chapters by Dr. Etheridge have been rewritten by Dr. Webster; those by Doctors Parvin and Earle have been partially rewritten and revised by the editor.

By reason of the extensive additions to the text, and to facilitate ease in handling the work, it has been deemed advisable to present the new edition in two volumes.

RICHARD C. NORRIS.
ROBT. L. DICKINSON.

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PREFACE.

ADVANCES in the science and art of obstetrics have kept pace with the advances which have characterized all branches of medicine and surgery. Although our standard text-books of obstetrics have occasionally been *revised*, an entirely new text-book containing the writings of more than one individual has not appeared during the last decade. The AMERICAN TEXT-BOOK OF OBSTETRICS owes its existence to the fact that it seemed practicable to produce a work which should not only embody the teachings of several prominent American obstetricians, thus reflecting all recent progress made in the theory and practice of obstetrics, but should also be a standard teaching-work for students and a guide for practitioners; for this purpose the authors selected are those possessing experience as teachers of obstetrics in several of the leading medical schools and hospitals of America.

The especial design in preparing this volume was to make clear those departments of obstetrics that are at once so important and usually so obscure to the medical student. Therefore the obstetric emergencies, the mechanics of normal and abnormal labor, and the various manipulations required in obstetric surgery are all described in great detail, the text being elucidated with numerous illustrations and diagrams which will materially assist the student to grasp the complex problems of operative obstetrics. The diseases of the fetus and of the new-born infant are given separate sections of the volume, this subject being discussed more fully than is usual in obstetrical works in the English language. An effort has been made to render attractive the sections upon Anatomy and Embryology.

While the various authors were each assigned special themes for discussion, nevertheless an attempt has been made so to correlate the subject-matter as to preserve throughout the text a logical sequence not always found in composite publications. The writing of the subjects assigned to Dr. Charles Warrington Earle was only fairly begun when his untimely and widely-lamented death occurred. The Editors were gratified to secure for the revision and completion of Dr. Earle's manuscript one of his associates, Dr. M. J. Mergler. The table of Contents indicates the authorship of each section—a feature which doubtless will give satisfaction.

One of the just claims of this text-book to originality is that an attempt has been made to carry out systematically the following principles in its illustration: All figures to be drawn to scale; a uniform scale to be adopted, usually one-third or one-sixth life size; in sagittal sections the same half always to be shown for ease of comparison; full labelling to be made directly on the drawing, to which should be given as much artistic treat-

ment as would be compatible with clearness and with teaching quality. The scale of the cuts in most previous text-books, and the choice of the sagittal section—right or left—have varied. In this book the left half of the section has preferably been chosen, because it is the one made familiar to practitioners by the treatment of patients in the latero-prone posture.

Each borrowed engraving has been credited to its source in all cases where it could be traced. When alterations have not been extensive these cuts are designated, respectively, as "redrawn from" or "modified from" the original. When such corrections and additions have been made as to constitute practically a new drawing, the origin of the cut is rarely indicated. Where there may seem to be strong resemblance to older work, without credit, it will be found that new photographs or sketches are the basis of the new illustration. The borrowed cuts have all been redrawn, excepting those reproduced from the old copper-plates of Hunter and Smellie—a standard of artistic excellence set for us by the most famous engravers of England. France, which has furnished our specialty with its stock-cuts for decades, gives the "American Text-Book" many suggestions through the work of Farabeuf and Varnier. To Germany obstetrics owes much gratitude for that accuracy in topographical anatomy which had its rise in the beautifully pictured sections of Braun, Schroeder, Waldeyer, and Zweifel; while we thank Scotland, through the atlases of Hart, Barbour, and Webster, for the knowledge of the structure of the pelvic floor.

Some of the finest pathological specimens illustrated in this text-book were photographed at the Army Medical Museum at Washington, D. C., through the painstaking courtesy of Dr. D. S. Lamb, while Dr. Farquhar Ferguson gave access to the New York Hospital Cabinet, and Professors Piersol and Hirst each brought forward some of their most striking preparations.

We are indebted to the staff of artists, Messrs. Max Colin, W. A. C. Pape, H. C. Lehmann, F. V. Baker, A. B. Doggett, F. Deck, W. H. Richardson, and others, by whose skill and years of patient labor art has been placed at the service of scientific illustration.

Only through an unprecedented liberality on the part of the publisher of a medical text-book has it been possible thus to re-illustrate an entire department of medicine. To Mr. W. B. Saunders, for his unremitting courtesy, patience, and generosity, we tender our thanks. The Editors desire to acknowledge their indebtedness to Mr. John Vansant for valuable assistance in conducting the mechanical details of the work and for the preparation of the Index.

The plan of this text-book, the exposition of only the latest ideas in pathology, the especial care that directions for treatment shall be particular and full, the avoidance of conflicting statements, and the wealth of illustration, are qualities which, it is hoped, will make this work an efficient guide to those who study or who practise Obstetrics.

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AN

AMERICAN TEXT-BOOK

OF

OBSTETRICS.

IV. DYSTOCIA.

1. Anomalies in the Forces of Labor.*

In a normal labor the active forces of expulsion (the uterine and abdominal muscles) and the passive forces of resistance (the fetus, the pelvis, and the maternal soft structures) are so nicely balanced that the expulsive forces are just sufficiently resisted to ensure a slow and gradual passage of the fetus along the birth-canal. The walls of the birth-canal and the structures around the vulvar orifice are by this arrangement slowly and gradually dilated, and are not rudely torn apart, as they would be by a more rapid expulsion of the fetus. This balance between the powers of labor, however, is easily disturbed. There may be anomalies by deficiency and anomalies by excess in the component parts of the forces of expulsion and in all the sources of resistance. Thus the uterine muscle may be too weak or too strong compared with the resistance it must overcome; and so also with the action of the abdominal muscles. The resistance furnished by the pelvis, the soft structures, and the fetus may be excessive or deficient.

1. Deficient Power of the Uterine Muscle; Inertia Uteri.

In this condition the uterine muscle is unable to overcome the normal resistance offered by the weight of the fetal body, by the friction of the pelvic walls, and by that of the undilated maternal soft structures. Inertia uteri is manifested in the vast majority of cases during the first stage of labor. The weakened uterine force therefore is almost always neutralized by the obstruction of an undilated cervix. There is scarcely another condition in obstetric practice that can be traced to such a variety of causes or that demands so many different plans of treatment.

Etiology.—Deficient power of the uterine muscle in labor may be due to a defect of the muscle itself, to some anomaly of innervation, or to a mechanical interference with the full and effective action of the muscle. Examples of the first-named cause may be found in imperfect development of the womb or in anomalies of development, as in *uterus bicornis*. The uterine muscle may be exhausted by rapidly-succeeding pregnancies. It may be over-distended by twins or by hydramnios, thus losing the power gained by cohesion of muscular bundles. The uterus may be weakened by some cause—as an adynamic fever or a wasting disease—that weakens the whole organism, but it does not necessarily follow that uterine weakness always accompanies a reduction of body-strength. The writer has seen women in the last stages of phthisis or in the midst of an attack of typhoid fever or pneumonia exhibit a uterine power in labor above the normal. The uterus may be weakened by profuse hemorrhage, as in placenta prævia. It may be rendered incapable of exerting normal force in dry labors. The liquor amnii having drained off completely early in the first stage, the uterus retracts upon the child's body, thus being subjected in

* The *superior* figures ([1]) occurring throughout the text of this article refer to the bibliography given on page 99.

certain regions to severe and long-continued pressure, and becoming in those spots anemic and friable, while in the areas free from the pressure of the child's body the uterine wall becomes congested, swollen, and edematous. Above all, the uterine muscle may become fatigued. This is the commonest cause of uterine inertia. It is seen oftenest in primiparæ, in whom inertia is more than twice as common as in multiparæ on account of the difficulty of dilating the rigid cervical tissues. Inertia may appear in consequence of any serious obstruction in labor. At first the pains are feeble, infrequent, and inefficient, but as labor continues the uterine contractions gather force. The inertia from this cause is likely to be only temporary, seen at intervals between periods of stormy uterine action or of long-continued tonic spasms, until finally exhaustion of the whole organism threatens the patient's life or the uterus ruptures.

It has been asserted that an anomaly of innervation in the anatomical sense, a deficient supply of the terminal nerves in the individual muscle-cells, is a cause of uterine inertia, but it is not yet clearly demonstrated to be so. An inhibitory nervous impulse to the uterine muscle, on the contrary, is a frequent cause of uterine inaction. It is the result of some emotion or of excessive pain. That the "doctor has frightened the pains away" on his first arrival has become proverbial in the lying-in room. The presence of any one who is a cause of embarrassment or is disagreeable to the patient may have the same effect. In hyperesthetic women the uterine contractions may be so exquisitely painful that their first onset is followed by an inhibitory impulse which cuts them short almost immediately. Every clinical observer has seen the phenomenon of rapidly-recurring, very painful uterine contractions, which are, however, of short duration, and which secure no appreciable dilatation of the cervical canal. A woman may be tortured thus for hours in the early part of the first stage of labor, when this inhibitory nervous impulse is commonly observed. With the continuance of labor the individual becomes more or less indifferent to her surroundings or more inured to suffering, and the inhibitory nerves, probably derived from the spinal cord, apparently lose the power of responding to the stimulus of pain.

Among the mechanical causes of inefficient uterine action during labor are fibroid tumors of the uterine walls, displacements of the womb, old peritoneal adhesions, and fresh outbreaks of periuterine inflammation.

Diagnosis.—The recognition of uterine inertia should always be easy. The contractions of the muscle are of short duration and are separated usually by long intervals, and by palpation the observer may convince himself that they are feeble. The uterus during the pain does not assume that intensely hard consistency which normal vigorous action of the muscle in labor occasions. The patient's expression, action, and demeanor point to deficient force during the pains. The woman is more placid, the face is less contorted, and there is less outcry during the contractions than in the normal parturient patient, except in those cases in which excessive pain inhibits uterine action. In these cases, however, abdominal palpation and the short duration of the pains are suf-

ficiently plain signs of the inertia. Finally, labor is delayed. During the first stage dilatation is slow or does not progress at all, and in the second stage the presenting part does not advance. One fatal error in the diagnosis of inertia uteri should be avoided: the physician should be sure that labor is not delayed by some obstruction. It has happened in a careless and superficial examination that the observer has taken the distended and thinned lower uterine segment for an inert womb. In such a case the measures adopted to stimulate the supposedly inactive uterine muscle to overcome an obstacle that is insuperable might easily be interrupted by rupture of the womb. A methodical and careful examination will guard one from this error. The source of obstruction will be discovered. The firmly, perhaps tetanically, contracted upper uterine segment may be contrasted with the inactive lower segment by palpation of the whole anterior surface of the womb. The contraction-ring should be visible, and the whole uterus stands out with unusual prominence, from the anteversion that always accompanies prolonged and powerful uterine contraction.

Treatment.—From the diversity in the causes of inertia uteri it follows that no single plan of treatment can be depended upon. If uterine action is inhibited by emotion, the cause of nervous disturbance should, if possible, be removed. An objectionable person should leave the room. If excessive pain prevents effective contractions, an analgesic should be administered. Nothing is better for this purpose than chloral administered in 15-grain doses, repeated, if necessary, twice at intervals of fifteen minutes. A quarter of a grain of morphia hypodermatically comes next in order of efficiency. If the uterine muscle is simply apathetic, it can be aroused by some direct irritant. The insertion of a bougie as for the induction of labor answers the purpose well. A more effective but more troublesome measure is the dilatation of the cervical canal by Barnes's bags. These not only irritate the uterine muscle and thus bring on strong contractions, but they also artificially dilate the cervical canal, and thus relieve the uterine muscle of a great part of its task in the first stage of labor. If the head should be well engaged in the pelvis, however, the insertion of the bags is difficult and they are likely to cause malpositions of the head. In such cases, if the os is dilated to the size of a silver dollar, nothing is so effective as the application of forceps—not with the idea of dragging the head through the undilated cervical canal, but to pull the head at intervals firmly down upon the cervix. The impact of the head upon the cervix acts as a powerful reflex irritant, and will excite as strong contractions as any direct irritant can do. Not only so, but the pull of the head upon the cervix will gradually dilate the canal as effectually as could strong propulsion from above. As soon as effective pains are established and the dilatation of the cervical canal progresses satisfactorily the forceps should be removed.

Inertia uteri so profound as to demand the somewhat radical measures just described is, fortunately, rare. More commonly the physician sees the minor grades, in which there is simply a flagging of uterine effort during the first

stage, especially in primiparæ, accompanied by every evidence of temporary physical and mental exhaustion. After a period of rest effective contractions will reappear, even if nothing whatever is done to aid the patient. The more complete the rest, the more vigorous will be the uterine action when it is resumed, and for this reason the administration of chloral and opium is often followed after a time by a satisfactory progress in labor. But these drugs necessarily retard the termination of labor by the time of rest they secure. It is ordinarily desirable, therefore, to resort to drugs of a stimulant character that shall at once revive the flagging uterus and so hasten the delivery. Many medicaments have been recommended for this purpose, but, of them all, alcohol, quinin, and ergot alone deserve consideration. The last was employed extensively at one time, but clinical experience forbids its use to-day. The contractions of the womb induced by ergot are likely to become tetanic. The uninterrupted contractions interfere with the fetal circulation; they may cause fatal intra-uterine asphyxia, and they often produce such exaggerated blood-presssure and stagnation of the current in the fetal body as to induce extravasations in important viscera, especially the brain. Further, the circular fibres of the cervix come under the influence of the drug, and by their firm contraction neutralize the contraction of the longitudinal fibres of the uterine body, and thus retard labor almost indefinitely; and, worst of all, should there be some obstruction to the descent of the child in the maternal pelvis or in the fetal body, the administration of ergot predisposes to rupture of the uterus. For these sufficient reasons this drug as a stimulant to the uterine muscle in the first and second stages of labor should be banished from the obstetrician's pharmacopeia, except in the single instance of the birth of the second of twins (see p. 96). Owing to the recommendations of Albert H. Smith and of Fordyce Barker, quinin has had, and still has, a great reputation as a stimulant to the uterus in labor. The writer's experience with the drug, however, does not permit him to subscribe to a belief in its efficacy as a uterine stimulant in labor. Quinin has the positive disadvantage, moreover, that it will occasionally in certain susceptible individuals produce a violent post-partum hemorrhage. In the minor grade of inertia under description, so often seen in primiparæ, and almost always the result of exhaustion, the writer has found nothing so useful as alcohol, in the shape of a wineglassful of sherry, taken slowly with a cracker, and given with the positive assurance that it will bring back the pains and hasten the conclusion of labor, for the patient needs moral and mental support as much as she requires a physical and muscular stimulus.

An impression prevails among general physicians that inertia uteri in the first stage of labor, before rupture of the membranes, may safely be disregarded. In a measure this view is correct. The writer has seen in a number of instances a partial dilatation of the os and then an entire cessation of uterine contractions for many hours and even for days. In one case the cervical canal was sufficiently dilated to receive four fingers, and it remained so for more than a week, the patient all the while going about on her feet in per-

fect comfort, without a single painful contraction of the womb. But should inefficient uterine contractions be accompanied by much pain, as happens in some cases of inertia, the long-continued first stage should not be regarded with indifference. The patient will in time show the irritant and depressant effects of long-continued suffering in an elevated temperature, an accelerated pulse, and a lessened resisting power of body-cells, the last playing an important *rôle* in the predisposition to sepsis after labor. Another consequence of delayed, painful labor may be seen in a sensitive, nervous individual, who is thrown into a state of excitement, and then from gloomy forebodings of harm to herself and to her infant passes into an almost maniacal condition of terror and dread.

It should be a rule of practice, therefore, to watch carefully all cases of inertia uteri, and to interfere as soon as the patient's mental condition or her pulse, temperature, and general vigor are demonstrably affected by the delay in labor.

2. Excessive Power in the Expulsive Forces of Labor.

An actual excess of power in the expulsive forces (the uterine and abdominal muscles) in labor sufficiently great to expel the fetus precipitately is extremely rare. A relative excess is not uncommon. The child's body may be so small, the pelvis so abnormally large, the maternal soft parts so relaxed, that the ordinary power exerted by the uterine and abdominal muscles is far in excess of that required to overcome the weak resistance offered, and the child is fairly shot out of the birth-canal. The rapid delivery may cause serious results to both mother and child. In the woman the structures on the pelvic floor may be lacerated severely; the sudden evacuation of the womb predisposes to hemorrhage from inertia; the placenta may be detached prematurely; and the sudden evacuation of the abdominal cavity predisposes to dangerous syncope. For the child the chief danger is the possibility of unexpected delivery of the mother in the erect posture. The umbilical cord may rupture, and the child, falling to the ground, may be injured fatally. Precipitate and unexpected labors occur most frequently when women are seated upon the water-closet. The child is evacuated into the waste-pipe or down a well, and may be destroyed. Some astonishing examples of infantile vitality, however, are furnished by such cases. In one instance a woman was unexpectedly delivered while seated upon the commode in a railway train moving at the rate of thirty miles an hour. As soon as she could communicate the startling intelligence to the conductor the train was backed until, several miles from the place where it was stopped, the infant was found upon the railway ties alive and well!* In another case, under the writer's observation, a young woman purposely discharged her fetus at term into the well of a privy twelve feet deep. Three bricks were thrown or fell down the well after the child and lay across its body. Eight hours after its birth the infant

* Professor William Osler told the writer of this remarkable occurrence. It happened on the Canadian Pacific Railroad.

was fished out of the bed of manure in which it was immersed to the neck, unharmed and in good condition.

Unfortunately, the physician is usually not at hand to prevent a precipitate delivery and to avert its consequences. Should he find an infant descending the birth-canal with a rapidity dangerous to itself and to its mother, he can easily retard its progress by pressure with his hand against the presenting part.

3. Deformities of the Pelvis.

Comprehensive and satisfactory knowledge of deformities in the female pelvis has been gained only in the latter half of the present century, since the appearance of Michaelis' work in 1851.[1] Until the announcement by Arantius in the last quarter of the sixteenth century that a contracted pelvis is a serious obstacle in labor, the prevailing belief had been that difficult labors from mechanical obstruction by the maternal bones were due to a failure on the part of the pelvis to expand sufficiently for the passage of the child. This idea continued in force for a number of years after Arantius' time. According to Litzmann, Heinrich von Deventer (1651–1724) should be regarded as the real founder of our knowledge of the pelvis and of its anomalies. He described the inclination of the pelvis, the axis of the pelvic inlet, the contracted pelvis, and the flat pelvis. Pierre Dionis was the first to point out (1718) the relationship between rachitis in childhood and a deformed pelvis in the adult. William Smellie's contributions to the study of the female pelvis were remarkably full and clear, when one considers how little was known before his time. His description of the rachitic pelvis, his reflections on its cause, and his accounts of illustrative cases may be read with profit to-day. Roederer, Stern, Cooper, Vaughan, Denman, Baudelocque, and Fremery added much to the stock of knowledge during the latter half of the eighteenth century. The men of the present century to whom we owe most of our present information about the pelvis and pelvimetry are Naegele, Kilian, Rokitansky, Michaelis, Robert, Litzmann, Neugebauer, and many others to whom reference will be made in the sections devoted to the particular varieties of deformed pelvis.[2]

Frequency of Deformed Pelves.—It is difficult to estimate the frequency in America of pelves sufficiently deformed to influence decidedly the course of labor. Statistics from our lying-in hospitals afford little aid to a correct conclusion, because the inmates are chiefly European immigrants and negresses. In the Boston Lying-in Hospital, however, deformed pelves were found in 2 per cent. of native-born and in 6 per cent. of foreign-born women (Reynolds).[3] The statistics of Williams, of Baltimore, and Crossen, of St. Louis, give a frequency of 7 per cent. among white women in large American cities. The writer's experience in private and consulting practice convinces him that deformed pelves are by no means rare among native-born women in the densely populated centres of the Eastern States. No general practitioner, in a large city at least, can hope to avoid such cases, and it is likely that each year will afford him one or more striking examples. It follows that an ability to recognize deformities of the female pelvis is a necessary equipment for every

practitioner of medicine who may be called upon to attend women in confinement, and that a knowledge of pelvimetry is as essential to the intelligent and successful practice of obstetrics as are percussion and auscultation to the practice of medicine. European statistics bearing on the frequency of contracted pelves give the following results: Michaelis found in 1000 parturient women 131 contracted pelves; Litzmann, 149. Winckel found in Rostock 5 per cent., in Dresden 2.8 per cent., and in Munich 9.5 per cent. of contracted pelves among pregnant and parturient women. Winckel believes that 10 to 15 per cent. of childbearing women have contracted pelves, but that in only 5 per cent. is the obstruction serious enough to be noticed. Kaltenbach puts the frequency of contracted pelvis at 14 to 20 per cent. In Marburg it was found to be 20.3 per cent., in Döttingen 22 per cent., in Prague 16 per cent. Schauta estimates it at 20 per cent. French statistics give a frequency of 5–16 per cent.; Austrian, from 2–8 per cent.; Russian, about 1–5 per cent.

Classification of Anomalies in the Female Pelvis.—All classifications are merely a convenience for the teacher and student. It is rarely possible to draw sharply-defined lines between varying manifestations of a condition. The majority of German authors follow Litzmann's classification of abnormalities of the female pelvis, by which they are broadly divided into those of size and those of shape. Modern French authors adopt the still less satisfactory division of over-size, under-size, and anomalies of inclination. The writer finds Schauta's classification the most convenient, and therefore utilizes it, with some slight modification.[4]

ANOMALIES OF THE PELVIS THE RESULT OF FAULTY DEVELOPMENT.

Simple flat;
Generally equally-contracted (justo-minor);
Generally contracted flat (non-rachitic);
Narrow funnel-shaped, fetal or undeveloped;
Imperfect development of one sacral ala (Naegele pelvis);
Imperfect development of both sacral alæ (Robert pelvis);
Generally equally-enlarged (justo-major);
Split pelvis.

ANOMALIES DUE TO DISEASE OF THE PELVIC BONES.

Rachitis;
Osteomalacia;
New growths;
Fractures;
Atrophy, caries, and necrosis.

ANOMALIES IN THE CONJUNCTIONS OF THE PELVIC BONES.

Abnormally firm union (synostosis), which is apt to be found in elderly primiparæ, particularly at the sacro-coccygeal joint:
Of symphysis;
Of one or both sacro-iliac synchondroses;
Of sacrum with coccyx.

Abnormally loose union or separation of the joints:
Relaxation and rupture;
Luxation of the coccyx.

ANOMALIES DUE TO DISEASE OF THE SUPERIMPOSED SKELETON.

Spondylolisthesis;
Kyphosis;
Scoliosis;
Kypho-scoliosis;
Lordosis.

ANOMALIES DUE TO DISEASE OF SUBJACENT SKELETON.

Coxalgia;
Luxation of one femur;
Luxation of both femora;
Unilateral or bilateral club-foot;
Absence or bowing of one or of both lower extremities.

Diagnosis of Pelvic Anomalies: Pelvimetry.—Deformities of the female pelvis may be detected by the history of the patient, by her appearance, by palpation of the exterior and interior of the pelvis, and by external and internal measurements of those pelvic diameters that are accessible, or of

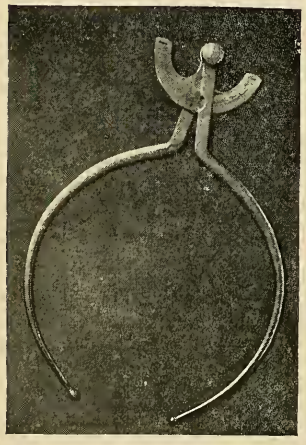


FIG. 1.—Modern combination of Baudelocque's and Osiander's pelvimeter.

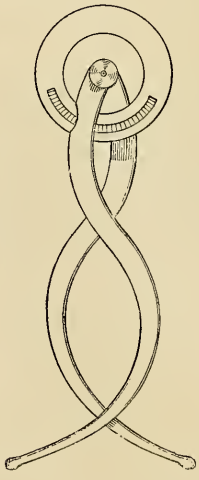


FIG. 2.—Osiander's pelvimeter.

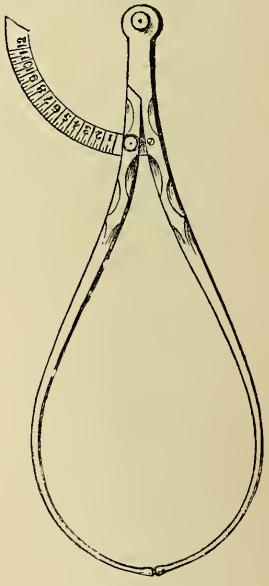


FIG. 3.—Martin's pelvimeter.

salient points on the woman's body corresponding as nearly as possible with the internal measurements desired; the relations between the two last having been ascertained by many observations on dead and living bodies. Radiography has a limited usefulness in the detection of anomalies of pelvic shape,

as in an obliquely contracted pelvis. For taking pelvic measurements the examiner's fingers, a tape-measure, and a modified mathematician's callipers—a pelvimeter—are usually employed. Baudelocque (1775) was the first to devise the pelvimeter in ordinary use. He laid the foundations of pelvimetry, and his instrument and methods are in use at the present time (Figs. 1–4). It is convenient to describe the measurements of the diameters of the pelvic inlet, pelvic cavity, and pelvic outlet separately.

Measurement of the Antero-posterior Diameter of the Superior Strait.—This measurement, the most important in the pelvis, cannot be taken directly. It must be estimated by several plans. Baudelocque was the first to point out the relation between the measurement from the depression under the last spinous process of the lumbar vertebræ to the upper edge of the symphysis pubis, and the true conjugate diameter of the pelvic inlet. To this external measurement the name "external conjugate" was given, but it is often called "the diameter of Baudelocque" (Fig. 6). Its discoverer believed the relation between the external and internal diameters to be constant—that the one exceeded the other by 8 to $8\frac{3}{4}$ centimeters—but in this he was mis-

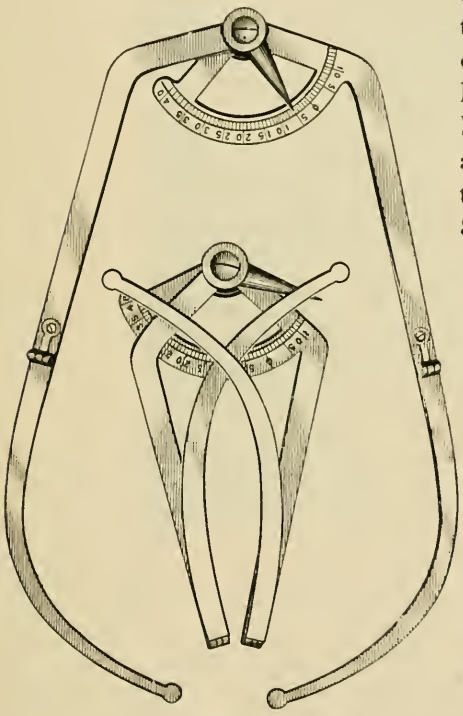


FIG. 4.—Harris-Dickinson portable pelvimeter.

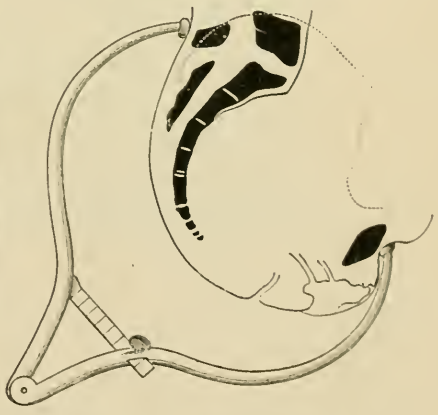


FIG. 5.—Measuring external conjugate.

taken. The line of the external diameter does not usually coincide with the line of the internal, and the thickness of bones and superimposed structures differs, of course, in each individual. In 30 cases in which Litzmann had an opportunity to compare the measurement of the external conjugate taken during life with the actual measurement of the true conjugate taken after death, there was an average difference of 9.5 centimeters, but the maximum difference was 12.5 centimeters and the minimum 7 centimeters—a variation of 5.5 centimeters in this small number of cases. Michaelis found a difference of 0.6 to 3.2 centimeters, and Schroeder $1\frac{1}{4}$ to 3 centimeters between the external conjugate of the living body and that of the dried specimen. The

measurement of the external conjugate, therefore, is not to be relied upon in making an estimate of the size of the true conjugate. It simply serves to indicate the probability or the improbability of pelvic contraction. An external conjugate of 16 centimeters or under means certainly an antero-posteriorly contracted pelvis; between 16 and 19 centimeters the pelvic inlet will be contracted in more than half the cases; between 19 and 21.5 centimeters there

FIG. 6.—Measuring the external conjugate diameter upon the living female.

will be but 10 per cent. of contracted pelves; and above 21.5 centimeters it is almost certain that the conjugate diameter of the pelvic inlet is not contracted at all. The external conjugate cannot be accurately measured without some practice. The beginner in pelvimetry will do well to remember the following rules:

Have the patient dressed for bed. Place her upon her side, with the thighs slightly flexed and the clothing rolled well up out of the way, the lower part of the body being covered with a sheet. The examiner stands at the patient's back, facing her head. The depression below the last spinous process of the lumbar vertebræ is found by rubbing a finger-tip over the lumbar spines from above downward until the finger sinks into the depression sought and feels no more prominent spinous processes below.* The knob at the end of one branch of the pelvimeter is placed firmly in this depression, and is held

* Michaelis preferred the measurement from the tip of the last lumbar spinous process, instead of from the depression below it.

there with one hand while the fingers of the other hand find a point on the symphysis pubis about $\frac{1}{8}$ of an inch below its upper edge, on which point the other branch of the pelvimeter is firmly set; the pelvimeter having been so placed that the indicator is turned toward the examiner, the measurement is therefore easily read off as soon as the pelvimeter is in proper position. It is on the average, in well-built women, $20\frac{1}{4}$ centimeters.

The best means for determining the length of the antero-posterior diameter of the pelvic inlet are the measurement taken from the lower edge of the symphysis pubis to the promontory of the sacrum, the diagonal conjugate diameter, and the distance between the upper outer surface of the symphysis pubis and the promontory of the sacrum. The diagonal conjugate diameter is one side of a triangle the other two sides of which are the height of the symphysis and the true conjugate. The distance between the outer upper surface of the symphysis and the promontory of the sacrum differs from the true conjugate by the thickness of the upper portion of the symphysis. Smellie was accustomed to estimate roughly the length of the true conjugate by a digital

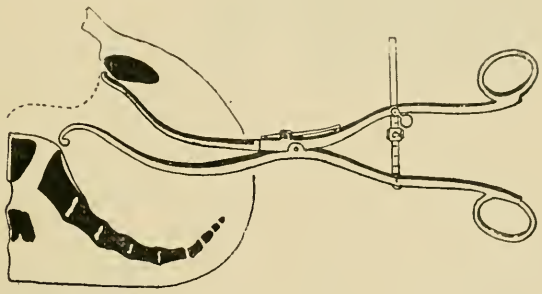


FIG. 7.—Stein's instrument for direct measurement of the conjugate.

examination, basing his estimate on the ease with which the promontory could be reached. In the latter part of the eighteenth century Johnson[5] proposed for estimating the size of the pelvic inlet a method which consisted in inserting the fingers of one hand in the mouth of the womb and then spreading them between the promontory and the sacrum. A few years later the elder Stein devised a graduated rod for measuring the distance between the lower edge of the symphysis pubis and the division between the second and third sacral vertebræ. This distance he believed to be $\frac{1}{2}$ to 1 inch greater than the true conjugate. Stein later constructed the instrument for the direct measurement of the conjugate shown in Figure 7. Many instruments have since been constructed on this principle, but they are impracticable in the living female, for obvious reasons. Baudelocque was the first to propose the measurement of the diagonal conjugate and the subtraction from it of an average figure ($\frac{1}{2}$ inch) to determine the length of the true conjugate. His method, exactly as he described it, is still in use, with the exception that two fingers instead of one are employed in measuring the distance between the symphysis and the promontory. To measure the diagonal conjugate correctly the examiner must have the skill that comes of practice, and he must conduct his examination in

a careful and methodical manner. The patient is put in the lithotomy position and is brought to the edge of the table or bed on which she lies, so that the buttocks project well over it. The examiner cleanses his left hand and anoints the first two fingers with an unguent; he then inserts these fingers, held stiffly extended, inward and upward till the tip of the second finger finds and rests upon the promotory of the sacrum. Care must be exercised not to take the last lumbar for the first sacral vertebra or *vice versâ*, nor the second for the first sacral vertebra — mistakes easily made in cases of so-called "double promontory." With the tip of the second finger resting firmly in place upon the middle line of the promontory the radial side of the hand is elevated until upon it is plainly felt the impress of the arcuate ligament under the lower edge of the symphysis. With a finger-nail of the other hand a mark is made upon this point of the examining hand, which is then withdrawn (Fig. 8). The distance between this mark and the tip of the middle finger held extended is taken by a pelvimeter. This distance is the diagonal conjugate. By the observation of

FIG. 8.—Measuring the diagonal conjugate diameter.

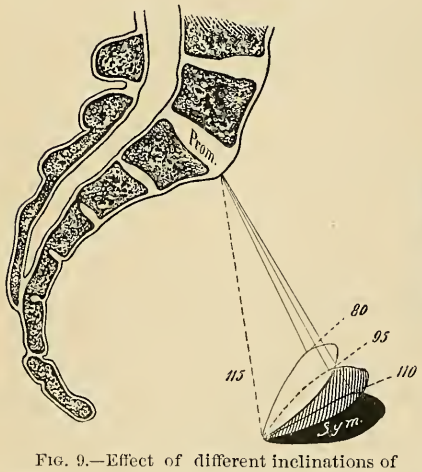


FIG. 9.—Effect of different inclinations of the pubis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

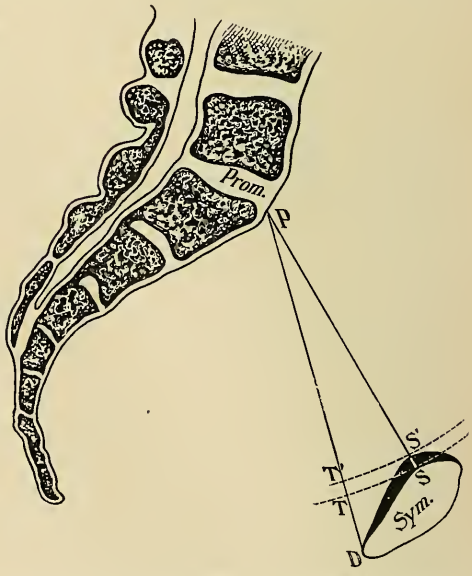


FIG. 10.—Effect of different thicknesses of the symphysis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

many subjects, alive and dead, an agreement has been reached that 1¾ centimeters should be subtracted from the diagonal conjugate to obtain the true conjugate diameter. But the acceptance of this average difference depends upon a normal height of the symphysis, 4 centi-

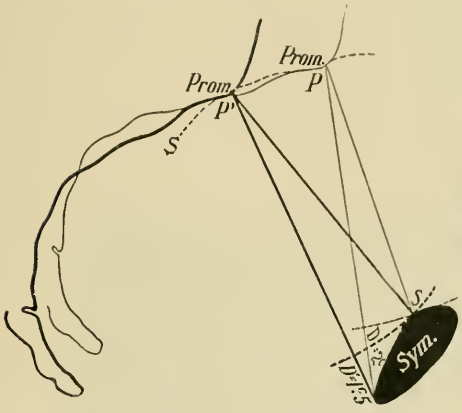


Fig. 11.—Effect of different heights of the promontory upon the relationship between the true and the diagonal conjugate (Ribemont-Dessaignes).

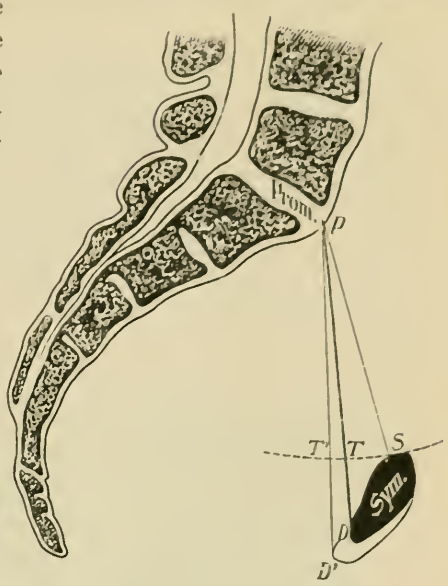


Fig. 12.—Effect of different heights of the symphysis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

meters, a normal angle between the axis of the pubis and the true conjugate, 105°, a normal thickness of the symphysis, and a normal height of the promontory (Figs. 9–13). These factors, however, are not constant, and if they vary much from the normal the most skilful and most experienced obstetrician may be woefully misled in his estimation of the true conjugate. The writer has had under his care a rachitic dwarf in whom there was more than 3 centimeters' difference between the diagonal and true conjugates, and Pershing found among 90 pelves in the museums of Philadelphia a difference varying from 0.8 centimeter to 3.6 centimeters. It is declared that these sources of error may be eliminated by the following corrections: For every degree of increase in the conjugato-symphyseal angle add half the number of millimeters to the sum to be subtracted from the diagonal conjugate, and *vice*

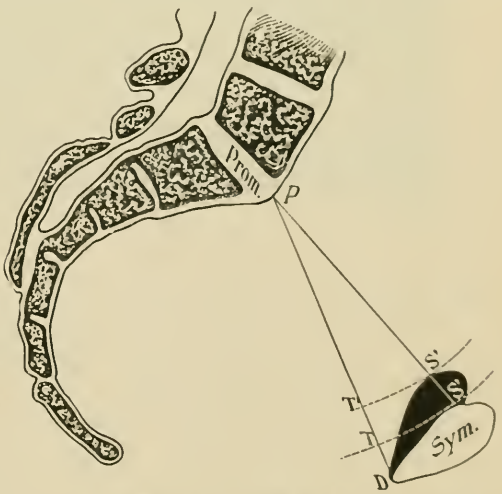


Fig. 13.—Effect of the lessened slant outward of the symphysis in a rachitic pelvis upon the relationship between the true and the conjugate diameter (Ribemont-Dessaignes).

versâ; also, for every 0.5 centimeter increase in the height of the symphysis over the normal add 0.3 centimeter to the sum to be subtracted from the diagonal conjugate, and *vice versâ*. While these rules are admirable for the study of the dried specimen in a museum, they are not easily applied to the living pregnant female. The height of the symphysis can be measured in the living subject, but an allowance for variations in this respect eliminates error in only a small proportion of cases. The variations in the angle of the symphysis, a much more important source of error, can only be surmised. The writer much prefers the measurement between the upper outer edge of the symphysis pubis and the promontory of the sacrum for the estimation of the true conjugate, having demonstrated its superior accuracy in practice.[6] For taking this measurement the patient is put in the dorsal position, with the

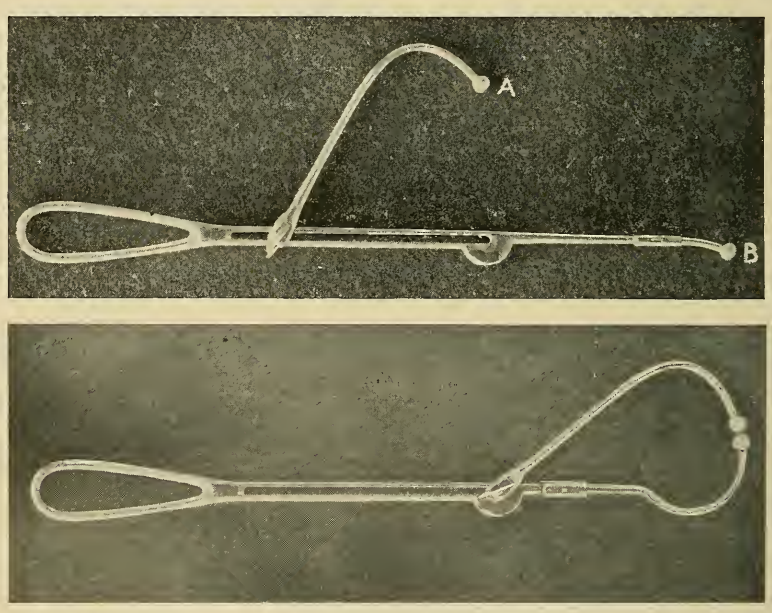


FIG. 14.—Hirst's pelvimeter: A, for measuring the true conjugate plus the thickness of the symphysis; B, with extra tip added for measuring the thickness of the symphysis.

buttocks projecting beyond the edge of the table or bed on which she lies. A mark with the point of a lead pencil is made on the skin over the symphysis pubis, about $\frac{1}{8}$ of an inch below the upper edge. The two fingers of the left hand are inserted in the vagina as in measuring the diagonal conjugate. The tip of the middle finger, having found the middle line of the promontory, is moved a little to the patient's right, and tip B of the pelvimeter, shown in Figure 14, is made to take its place. While the examining physician holds the shaft of the pelvimeter firmly in place an assistant adjusts tip A of the movable bar over the mark made on the symphysis. This bar is then screwed tight, the whole pelvimeter is removed, and the distance between the tips is found by a tape measure. This distance is the conjugate plus the thickness of the symphysis (Fig. 15). The latter the writer has found to be

1 centimeter in twenty-six dried pelves, 1¼ centimeters in nine, 1½ centimeters in thirteen, 1¾ centimeters in four, and 2 centimeters in three specimens, one a high-grade rachitic pelvis, another of the masculine type, and the third a justo-major pelvis. The thickness of the symphysis is measured as shown in Figure 16. In living subjects the index finger of the left hand must find the inner surface of the symphysis pubis, and follow it up to within about ⅛ of an inch of the top, where it bulges to its full thickness. On this point one tip of the pelvimeter is placed, and it is then held in position between the ends of the first and second fingers; the other tip of the instrument is adjusted over the mark made on the skin externally: the distance is read off from the indicator provided for the purpose. It is not necessary to make an allowance for the thickness of the tissues over the symphysis, for this is included in both measurements, and on subtracting one from the other the necessary correction is of course made. The tissues over the inner surface of the symphysis can usually be so compressed by the knob of the pelvimeter as to be practically eliminated. If this is impossible, as may happen in some primiparæ, a small allowance may be made for these tissues—say, at the most 0.5 centimeter. In taking this measurement it may be necessary to anesthetize the patient; and this is well worth while if a decision between some of the more serious obstetrical operations is to be based, as it must be, upon an accurate estimation of the true conjugate.*

FIG. 15.—Measuring the true conjugate plus the thickness of the symphysis.

FIG. 16.—Measuring the thickness of the symphysis.

Measurement of the Transverse Diameter of the Superior Strait.—The

* Wellenbergh was the first to employ this principle in pelvimetry. His pelvimeter was improved upon by Van Huevel, and in recent times by Skutsch and by Bullitt (*Deutsche medicinische Wochenschrift*, No. 13, 1890; *American Journal of Obstetrics*, 1893; Müller's *Handbuch der Geburtshülfe*, vol. ii. pp. 255, 260, 261).

transverse diameter of the pelvic inlet cannot be measured directly, nor can it be estimated accurately. Fortunately, this is not necessary. It answers the requirements of practice to determine whether there is a diminution of this measurement, without determining the exact degree of lateral contraction. To do this the following measurements are relied upon: The distance between the anterior superior spinous processes of the iliac bones, which in well-formed women is 26 centimeters; the distance between the crests of the iliac bones, 29 centimeters; the distance between the trochanters, 31 centimeters; the distance between the posterior superior spinous processes of the iliac bones, 9.8 centimeters; the distance between the subpubic ligament and the upper anterior angle of the great sacro-sciatic notch, which, according to Löhlein, is 2 centimeters less than the transverse diameter of the inlet; finally, an estimation of the width of the pelvic inlet by a vaginal examination. In taking the external measurements the woman is placed upon her back. The salient points are easily found except in the case of the iliac crests. They are discovered by

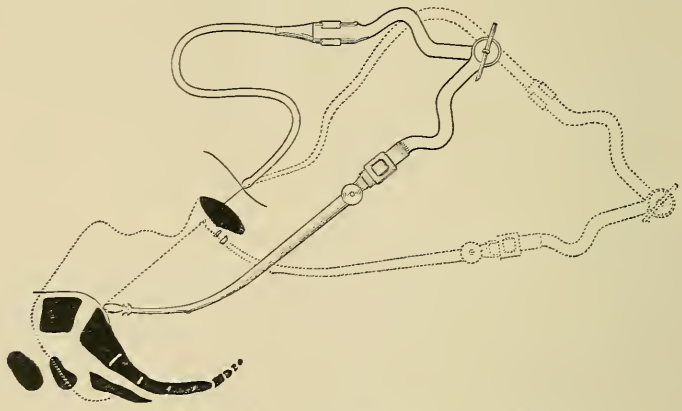


FIG. 17.—Skutsch's method of measuring the conjugate diameter.

moving the knobs of the pelvimeter evenly along the crests of the ilia until the two opposite points most widely separated from each other are found. If the crests are no farther, or even less, separated from each other than the spines, points 5 centimeters back of the latter are arbitrarily selected as the sites of the crests. The posterior superior spinous processes are often marked by distinct dimples on the woman's back. The internal measurement of Löhlein is made by the fingers in the vagina. If all these measurements are much less than normal, a lateral contraction of the pelvis may be assumed, and the degree of contraction is roughly estimated by the amount of decrease in the measurements, although the relations between these measurements and the distance sought is very variable. The efforts of Skutsch and of others before him accurately to measure the transverse diameter of the pelvic inlet by combined internal and external measurements cannot be said to have yet been crowned by success. The softness of the tissues externally permits the external knob of the pelvimeter to sink into the flesh to a varying degree, and the same is true of the structures within the pelvis. It is difficult also to keep the pel-

vimeter in the same straight line when the internal knob is changed from one side to the other (Figs. 17, 18). Moreover, better results in practice may be obtained by an estimate formed by a vaginal and a combined examination, under anesthesia if necessary, of the relative size of the transverse diameter of the pelvic inlet and the antero-posterior diameter of the child's head.

Measurement of the oblique diameters of the pelvic inlet is required only in obliquely-contracted pelves. It will be referred to in the description of these pelves.

The Measurement of the Capacity of the Pelvic Cavity.—The capacity of the pelvic cavity must be estimated by vaginal examination. There is no plan by which accurate measurements can be made. It is sufficient to estimate the size and the shape of the pelvic canal by palpating the lateral walls of the pelvis; by determining the curve, perpendicularly and laterally, of the sacrum; by noting the height of the sacro-sciatic notches,

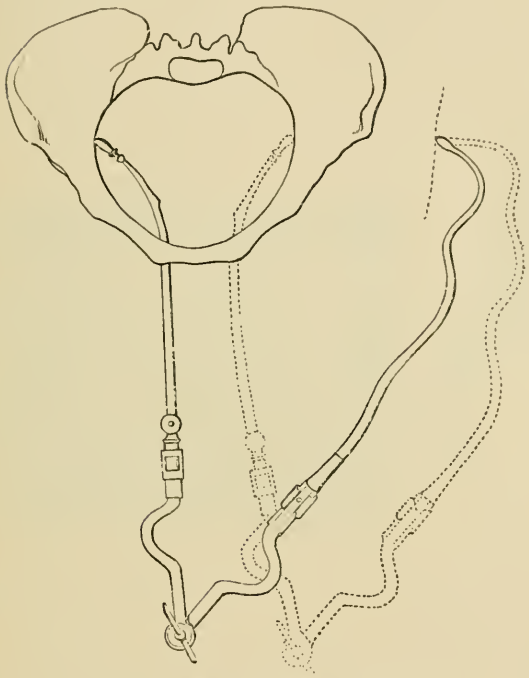


FIG. 18.—Skutsch's method of measuring the transverse diameter of the pelvic inlet.

FIG. 19.—Measurement of the antero-posterior diameter of the pelvic outlet.

the approximation of the tuberosities of the ischia, the depth of the pelvis, and the direction of its canal; by detecting, possibly, the presence of an exostosis, an osteosarcoma, an abnormally-projecting spinous process, an old fracture, or asymmetry of the pelvic walls from any cause.

Measurement of the Transverse Diameter of the Pelvic Outlet.—The antero-posterior diameter of the inferior strait is enlarged during labor by the displacement backward of the coccyx. The transverse diameter between the tuberosities of the ischiatic bones is constant, and if there is contraction of the outlet the greatest resistance to the escape of the fetus is furnished by these firm bony eminences. The transverse diameter of the pelvic outlet can be measured directly with ease. The woman is placed in the dorsal position with thighs and legs flexed. The distance between the tuberosities of the

ischia is measured with a pelvimeter, or the examining physician places his thumbs squarely on the tuberosities, and an assistant measures the distance between the physician's thumb-nails.

If it should be desired to measure *the antero-posterior diameter of the pelvic outlet*, this may be done as shown in Figure 19, 1.5 centimeters being subtracted for the thickness of bone and superimposed structures.

4. Description of the Several Varieties of Abnormalities in the Female Pelvis.

The simple flat pelvis (Fig. 20) is the earliest recognized form of contracted pelvis—the *pelvis plana* of Deventer, who did not, however, make a distinction between the simple flat and the rachitic flat pelvis. It is doubtful, indeed, if he knew the difference between the two. Betschler was the first to point out the distinctive features of this form of pelvis. In Europe it is the commonest variety of deformed pelvis. Schroeder states that it is seen more frequently than all the other forms put together. In America it is also common, but the equally generally-contracted pelvis is encountered here as often or perhaps oftener. Out of a series of 316 pelves in women of American birth the writer has found eighteen (a percentage of 5.6) with the measurements characteristic to some degree of a simple flat pelvis.

Characteristics.—In the simple flat pelvis the sacrum is small and is pressed downward and forward between the iliac bones, but is not rotated forward on its transverse axis. The antero-posterior diameter is contracted, therefore, throughout the whole of the pelvic canal. The contraction, however, is not often great. It is scarcely ever below 8, and is usually not under 9.5, centimeters.*

The transverse diameter is as great as, or possibly greater than, that of the normal pelvis. Occasionally, however, in pelves approaching the type of the generally-contracted flat pelvis the transverse diameter may be found somewhat diminished. There is in these pelves quite frequently a double promontory formed by the abnormal projection of the cartilaginous junction between the first and second sacral vertebræ. The line drawn between the lower promontory, or the second sacral vertebræ, and the symphysis is often as small as, or smaller than, the true conjugate.†

Etiology.—The simple flat pelvis has been ascribed to heredity, to an arrested rachitis, to overwork before puberty (especially the carrying of heavy weights), to premature attempts to walk or to sit up, and to the weight of a heavy trunk upon a pelvis ill fitted to bear it on account of weakness of its ligaments. It is probable that in the majority of these pelves the form is

* Engelken has described a specimen with a true conjugate of 4.8 centimeters, a diagonal conjugate of 7.5 centimeters, with transverse and oblique diameters of the inlet 13.3 and 12.4 centimeters respectively. This specimen is unique.

† Credé found in nine pelves with a double promontory the conjugate from the true promontory longer in four and shorter in three cases than the conjugate measured from the false promontory. In two cases the two conjugates were of equal length (*Klin. Vorträge ueber Geburtshülfe*, Berlin, 1853).

inherited and congenital. It has been found by Fehling in a number of fetuses and new-born infants.

Diagnosis.—The simple flat pelvis is easily overlooked. There is nothing in the patient's appearance or history to suggest the deformity, unless she has had difficulty in previous labors. The characteristic signs are the diminished antero-posterior diameter, determined by internal and external measurements, and a transverse diameter as great as, or greater than, normal, or perhaps a trifle under the normal measurement. This last point is determined by measurements externally and by the internal palpation of the pelvic canal. In measuring the conjugate diameter of this pelvis one must take into account the lessened inclination of the symphysis outward, its height, somewhat below the normal, and the low position of the promontory. Usually the average sum of $1\frac{3}{4}$ centimeters is a sufficient amount to subtract from the diagonal conjugate. If there is a double promontory, as is frequently the case in this form of pelvis, the conjugate must be measured from the promontory nearest to the symphysis, usually the lower (Fig. 21).

Fig. 20.—Simple flat pelvis (model in Hirst Collection, University of Pennsylvania): c. v., $8\frac{1}{2}$ cm.; tr., $13\frac{1}{4}$ cm.; obl., $12\frac{3}{4}$ cm.*

Fig. 21.—The two conjugates of a double promontory (Ribemont-Dessaignes).

Influence upon Labor.—From the failure of the presenting part to enter the pelvis during the last weeks of gestation there is frequently some degree of pendulous abdomen, especially in women with abdominal walls relaxed from previous pregnancies. The uterus is sometimes broader than common, and is often tilted to one side. The presenting part, if the head, may be loose above the superior strait, resting on one iliac bone or on the symphysis, or it may be pressed down firmly upon the brim in a transverse position, to accommodate its longest diameter to the longest diameter of the pelvic inlet. Malpresentations are common, as is also prolapse of the cord and of the extremities. The membranes may protrude in a cylindrical pouch from the external os as the liquor amnii is forced out of the uterus without obstruction from

* The abbreviations *tr.* and *obl.* will be used throughout to designate the transverse and oblique diameters of the pelvic inlet.

the imperfectly engaged head. From the same cause an early rupture of the membranes is likely. According to Litzmann, natural forces end the labor in 79 per cent. of cases, but in 50 per cent. the head is not fully engaged until the os is completely dilated. The dilatation of the os proceeds slowly, for the head does not descend low enough to press upon the cervix. Consequently the dilatation must be effected by a retraction of the cervix over the head or by the distended membranes. Should these rupture, the os, although considerably dilated, may retract until the head at length descends and again dilates it. After the obstruction at the superior strait is passed—where, of course, it is greatest—the head usually descends the remainder of the birth-canal with ease and rapidity, but labor may be prolonged by an exhaustion of the natural forces in the attempt to secure engagement. The apparent anomalies in the mechanism of labor characteristic of this deformed pelvis are in reality the best possible provision for the spontaneous obviation of the obstruction. The transverse position of the head at the inlet, the increased lateral inclination, and the imperfect flexion are designed to accommodate the size and the shape of the head to the unnatural size and shape of the pelvic inlet. An explanation of these peculiarities in the engagement of the head can be found in the altered relation of expulsive and resistant forces. The head, forced down upon the flattened brim and free to move upon the neck, rotates until its longest diameter is adjusted to the greatest diameter of the inlet—the transverse. It seeks the direction of least resistance, as any inert body will when propelled through a contracted canal. But the transverse position of the head alone is not sufficient to overcome the obstruction. The biparietal diameter of the head is too large to enter the conjugate of the pelvis. The occiput, the bulkiest portion of the skull, seeks the greater space to one side of the promontory, and is pushed against the lateral brim of the pelvis, the ilio-pectineal line. Here it is arrested. Further propulsion of the head is secured by a movement of partial extension, which brings rather the small bitemporal than the larger biparietal diameter of the head in relation with the contracted conjugate. Still, the obstruction may not be overcome. Both sides of the head may be unable to enter the pelvis at once. One side is propelled into the pelvic canal, the other is held back. That side which encounters the most resistance will naturally be the last to enter. Thus it is that usually the anterior parietal bone, slipping more easily past the symphysis, enters first. To this result also the inclination of the pelvic axis to the axis of the trunk contributes. Owing to the anterior position of the whole sacrum and to the diminished antero-posterior diameter of the pelvic outlet, on account, also, of the transverse position of the head and of its imperfect flexion, rotation of the head on the floor of the pelvis occurs late, and occasionally fails altogether, the head being expelled from the vulva in its original transverse or in an oblique position.

The localized pressure to which the maternal structures are subjected results sometimes in necrosis of cervical tissue over the promontory and of the anterior vaginal wall behind the symphysis. On the child's head the caput succedaneum is not exaggerated, because the head, when once firmly

engaged in the pelvis, descends the birth-canal rapidly, but there is apt to be a depression on that portion of the skull applied to the promontory—namely, on the posterior parietal bone between the greater fontanelle and the parietal emi-

Fig. 22.—Depression in the parietal bone caused by the pressure of the promontory (Winckel).

nence, usually quite close to the sagittal suture (Fig. 22). Sometimes a succession of these depressions or a gutter-shaped groove may be noted in a line running outward and forward on the child's skull. More frequently the course of

Fig. 23.—Marks made by the promontory on the child's head and face.

the head and face over the promontory is marked by a red streak running from the depression before noted in a line parallel with the coronal suture toward the temple if the head is well flexed after engagement, or to the outer corner of the posterior eye, or, in case of extreme flexion, to the cheek (Fig. 23).

Usually the posterior parietal bone is depressed below the anterior, which overlaps it at the sagittal suture. The posterior side of the skull is also flattened from the greater and more prolonged pressure to which it is subjected. Ordinarily the lateral inclination of the child's head is in a direction from before backward, so that the anterior parietal bone presents at the centre of the superior strait. Occasionally this inclination is so exaggerated that the ear is the presenting part. Exceptionally the lateral inclination takes the opposite direction, the anterior parietal bone catches on the rim of the pubic bones, and the posterior parietal bone is the first portion of the child's head to enter the pelvis. The presentation of the posterior fontanelle occurs even in normal pelves as a rare exception, but is seen in about 10 per cent. of contracted pelves (Schauta), and is the result in them very likely of firm abdominal walls and an increased inclination of the pelvic inlet to the axis of the trunk. In these cases the anterior parietal bone is pushed under the posterior at the sagittal suture. When the posterior side of the head by descent finds room in the hollow of the sacrum and moves backward, the anterior portion of the skull glides over the symphysis, and the sagittal suture moves from its original position, just behind the symphysis, toward the median line of the pelvic canal. In addition to these anomalies of mechanism, Breisky describes what he calls an "extra-median" engagement of the head in cases of flat pelvis in which there is considerable lordosis of the lumbar vertebræ. The head in extreme flexion is forced down upon half of the pelvic inlet, and enters the pelvic canal on this side alone. Directly the obstructing promontory and lumbar vertebra are passed the head descends the pelvic canal with rapidity and ease. This mechanism was noted nineteen times in Breisky's clinic among 2002 labors.[7]

Justo-minor Pelvis.—In this type of contracted pelvis the form of the female pelvis is preserved, but the size is diminished (Pl. 29, Fig. 1). Three divisions of this pelvis are commonly made: The *juvenile*, in which the bones are small and slender; the *masculine*, in which the bones are large, heavy, and thick; and the *dwarf*, or *pelvis nana*, in which the pelvis is very diminutive in size and the pelvic bones are not joined by bony union, but are separated by cartilage as in the infant. The innominate bones are divided into their three parts, and the sacral vertebræ are distinct from one another (Pl. 29, Fig. 2). The justo-minor pelves pass by insensible gradations into the simple flat, the transversely-contracted, and the generally-contracted flat pelves. In the larger cities of the United States the justo-minor pelvis is very frequently encountered. It is certainly as common here as is the simple flat pelvis, and if one were to judge from hospital patients, among whom there is a large proportion of shop- and factory-girls, this variety of contracted pelvis would be regarded as the commonest.

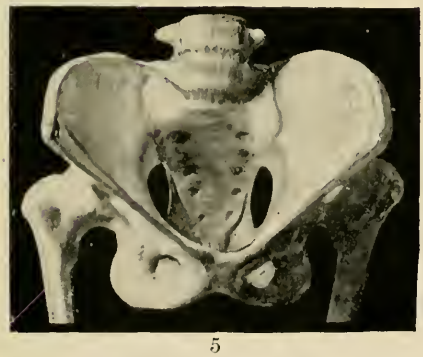
Characteristics.—While it is convenient to speak of the justo-minor pelvis as the normal female pelvis in miniature, the description is not strictly accurate. There are peculiarities due to an arrest of development which give to the equally generally-contracted pelvis some of the features of an infantile pelvis. The alæ of the sacrum are narrower than they should be in compari-

C. v. 9¼ cm. Tr. 11 cm. 1 Obl. 10¾ cm.

2

C. v. 9½ cm. Tr. 12⅛ cm. 3 Obl. 11¾ cm.

C. v. 10⅛ cm. Tr. (inlet) 8¾ cm. 4 Tr (outlet) 7 cm. Ant. post. outlet 7¼ cm.



5

6

7

8

1. Justo-minor pelvis (Mütter Museum, College of Physicians, Philadelphia), inlet a perfectly symmetrical ovoid. 2. Dwarf pelvis. 3. Justo-minor pelvis with ruptured pelvic joints, following forceps application (Hirst Collection, University of Pennsylvania). 4. Narrow, funnel-shaped pelvis (specimen in the Hirst Collection, University of Pennsylvania). 5. Fetal ill-developed pelvis, probably an arrested development from rachitis (Mütter Museum, College of Physicians). 6. Minor grade of narrow, funnel-shaped pelvis with contracted pubic arch. 7. Obliquely-contracted pelvis (Naegele). 8. Obliquely-contracted pelvis (photographed from a plaster cast).

son with the bodies of the vertebræ. The sacrum is short and is not pushed as far forward between the iliac bones as it usually is; it shows also a diminished forward inclination, and on its anterior surface a greater lateral, and a less marked perpendicular, concavity than common. The distance between the posterior superior spinous processes of the iliac bones is relatively great, on account of the posterior position of the sacrum and its slight rotation forward. The conjugato-symphyseal angle is greater than normal, by reason of the lessened inclination outward of the symphysis and the pubic bones. The promontory is high and not prominent, and the inclination of the pelvic entrance to the abdominal axis as the individual stands erect makes a more obtuse angle than it does in the normal pelvis. The bones in this form of contracted pelvis are commonly small and slender, except in that somewhat unusual variety the masculine pelvis, in which they are firm and thick beyond the normal. Women with a justo-minor pelvis are ordinarily of slight build and below the medium height; but this pelvis may be found in individuals of ordinary stature, and sometimes actually in tall women of large frame.

The true dwarf pelvis (Pl. 29, Fig. 2) is very rare. It is found only in women of dwarf stature. The bones are slender and fragile, and the cartilaginous junction between the original divisions of the pelvic bones is preserved. There is extreme contraction of the pelvic canal.

In the commoner kinds of justo-minor pelvis the contraction is not often very great. The conjugate diameter is seldom below 9, and scarcely ever so low as 8, centimeters. The pelvic outlet in some cases is laterally contracted; in others it is comparatively roomy.

Etiology.—The justo-minor pelvis is the result of arrested development; it may be found in women descended from a stock that has deteriorated physically, or in women subjected during childhood, infancy, or intra-uterine existence to unfavorable hygienic surroundings or conditions.

Diagnosis.—The justo-minor pelvis is easily confused with a rachitic pelvis, but the distinction is readily made by careful pelvimetry. All the measurements, while equally reduced, bear their normal proportion to one another, except in the case of the external conjugate diameter, which is apt to be longer than would be expected, on account of the posterior position of the sacrum and its lessened inclination forward. In estimating the true conjugate diameter from the diagonal conjugate one must take account often of the increase in the conjugato-symphyseal angle, and must remember that the sum to be subtracted from the diagonal conjugate is not infrequently greater than common. The symphysis is less in height than in the normal pelvis, but the error of computation from this source may be disregarded. Löhlein lays special stress upon the importance of measuring the pelvic circumference in making the diagnosis of this form of contracted pelvis. It is always far below the normal, 90 centimeters. An internal examination of the pelvic cavity and inlet should be made carefully, to determine approximately their capacity, with a special regard to the approximate length of the transverse diameters.

Influence on Labor.—The mechanism of labor shows far fewer anomalies

in this than in any of the other forms of contracted pelvis. The head, from the greater resistance encountered, is strongly flexed. It may be placed transversely, but is quite commonly oblique, and may even be antero-posterior in position if there is a tendency to lateral contraction of the pelvic canal. By the perfect flexion of the head the obstruction to the progress of labor is in great part obviated. If anything interferes with this movement of the head, as a faulty application of the forceps, engagement and descent may become impossible. Pelvic presentations in labor are a great disadvantage by reason of the difficulty experienced in freeing the arms and in bringing the head last through the generally-contracted pelvic canal. To secure its rapid passage, the child's head must be flexed strongly by the operator's finger in its mouth before an attempt is made to secure engagement in the superior strait. While the woman escapes localized necroses of the soft tissues following labor in the justo-minor pelvis, there is greater likelihood of rupturing pelvic joints in this than in any other variety of contracted pelvis, and there is also an extraordinary liability to eclampsia (Pl. 29, Fig. 3). The caput succedaneum, which is very large on account of the early fixation of the head and the long labor, is situated directly over the smaller fontanelle. There is an overlapping of the cranial bones both laterally and antero-posteriorly.

The generally-contracted, flat, non-rachitic pelvis presents the combined features of the flat and the generally-contracted pelvis.

Characteristics.—All the diameters are below normal, but the conjugate is less in proportion than any of the others. This pelvis has many of the features of a rachitic pelvis, but the anterior half of the pelvic circumference is not markedly broadened; indeed, it is often the reverse. The sacrum is small and is not rotated on its transverse axis; it is placed farther back between the innominate bones than in the normal pelvis, and very much farther back than in the rachitic pelvis. The promontory is high and is not prominent. The influence of this deformity of the pelvis upon labor is that of a flat pelvis, but the difficulties are greater than in the case of the simple flat pelvis, for there is less compensatory room in a transverse direction. The generally-contracted non-rachitic flat pelvis is comparatively rare. The flattening, according to Litzmann, is due to a shortening of the innominate bones, especially at the ilio-pectineal line. In estimating the true conjugate diameter of the generally-contracted flat pelvis it is safer to subtract 2 instead of $1\frac{3}{4}$ centimeters from the diagonal conjugate, on account of an increase in the conjugato-symphyseal angle, the result of the high position of the promontory and the diminished slant outward of the symphysis.

Etiology.—This generally-contracted type of pelvis is due to hereditary influence or to an arrest of development in the embryo, fetus, or infant. It is claimed, however, that it may be produced by premature attempts to walk and by long standing upon the feet in very early life.

Diagnosis.—The recognition of a generally-contracted flat pelvis is difficult. The measurements usually resemble those of a generally equally-contracted pelvis, but the conjugate diameter is less than one expects in that form

of contracted pelvis, and the mechanism of labor is that of a flat pelvis. The diagnosis can be made by finding the reduced conjugate diameter and by the ease with which one can reach the lateral pelvic wall in the palpation of the interior of the pelvic canal. A certainty of diagnosis can be obtained during life only by the direct measurement, not only of the conjugate diameter, but also of the transverse, by the methods of Löhlein and of Skutsch.

The Narrow, Funnel-shaped Pelvis; Fetal or Undeveloped Pelvis.—This variety of pelvis is contracted transversely at the pelvic outlet, or both in the transverse and antero-posterior diameters, without abnormalities in the spinal colum. The depth of the pelvic canal is much increased by the length of the sacrum, of the symphysis, and of the lateral pelvic walls. The sacrum is narrow, has little perpendicular curve, and is placed far back between the ilia (Pl. 29, Figs. 4, 5). Schauta ascribes this form of contraction to an anomaly of development by which the pelvic walls are lengthened downward and the weight of the body is thrown backward upon the sacrum. It is said to be very rare, but it has been found quite frequently in those hospitals where the outlet of the pelvis is regularly measured. It comprises from 5 to 9 per cent. of all contracted pelves, according to Breisky, and Fleischmann found twenty-four examples in 2700 parturient women.[8] A slight manifestation of the deformity is often called a "masculine" pelvis by reason of the diminution in the breadth of the pubic arch. This degree of the funnel-shaped pelvis is frequently encountered (Pl. 29, Fig. 6).

Diagnosis.—The diagnosis of a narrow, funnel-shaped pelvis is made by a comparison of the measurements of the pelvic inlet with those of the outlet. The former are found to be normal or even greater than normal, while the measurements of the outlet are diminished. If, as is the rule in extreme degrees of this deformity, the inlet and cavity are contracted, the outlet is still smaller in proportion. A careful palpation of the pelvic canal is an important aid to a correct diagnosis. The pelvic walls are felt to converge as they approach the outlet; the narrowness of the pelvic arch is appreciated, and the approximation of the tuberosities and spines of the ischiac bones is noticeable.

Influence upon Labor.—The peculiarities of mechanism in labor are malpositions of the head at the outlet (as backward rotation of the occiput), oblique and transverse position of the head, and imperfect flexion. There is also an insufficiency of the expulsive forces, the greater part of the fetal body being contained in the lower uterine segment, cervix, and vagina, while the upper muscular segment of the uterus is in great part emptied and therefore powerless. By the approximation of the pubic rami the presenting part is forced backward, and serious lacerations of the perineum are to be feared. The pressure of the head upon the lower birth-canal may result in necrosis of soft structures or lacerations along the descending rami of the pubis and the ascending branches of the ischium. The tissues over the projecting spines of the ischiac bones are also the seat of tears or of necroses. The narrowing of the pubic arch may lead to serious injuries if the forceps be applied. The writer has seen long clean cuts in the anterior vaginal walls, and profuse hem-

orrhage, following the use of instruments. In well-marked examples of the narrow, funnel-shaped pelvis, with a transverse diameter at the outlet not much below 3 inches, symphysiotomy gives the best chance of a successful termination for mother and child. Higher grades of contraction with a diameter of 2 inches and under demand Cesarean section. In lesser grades the woman may be delivered spontaneously or by forceps.

Obliquely-contracted Pelvis from Imperfect Development of the Ala on one Side of the Sacrum (Naegele Pelvis).—This pelvis was first described in 1834 by Franz Carl Naegele,[9] but had been noticed as early as 1779 without a full understanding of its significance (Pl. 29, Figs. 7, 8).

Characteristics.—The pelvic inlet has an oval shape, with the small point of the oval directed to the atrophied side of the sacrum. The sacral ala is atrophied or is absent, not only in that portion of the bone entering the sacro-iliac joint, but also in the transverse process along its whole length. The sacro-iliac joint on this side is ankylosed in the vast majority of cases, but not invariably. The sacrum is narrow, asymmetrical, and turned with its anterior face toward the deformed side of the pelvis. The promontory is not only turned in this direction, but is also pulled over to the diseased side. The innominate bone on this side is pushed as a whole upward, backward, and inward, and its anterior face is pushed inward and backward. The tuberosity of the ischium, as a necessary consequence of the displacement of the innominate bone, is higher than its fellow, projects into the pelvic canal, and is so turned that it looks rather antero-posteriorly than laterally. The spine of the ischium is brought quite close to the corresponding edge of the sacral bone and juts prominently forward into the pelvic canal. The whole innominate bone on the diseased side lacks its normal curvature at the ilio-pectineal line, and may run almost straight from the sacro-iliac junction to the symphysis pubis. The opposite innominate bone has a greater curvature than common, especially in its anterior half; otherwise it is practically normal in structure, position, and inclination. The symphysis pubis is pushed toward the healthy side of the pelvis, and its outer surface, instead of looking directly forward, is inclined to the diseased side. The pubic arch likewise faces somewhat in this direction ; its aperture is asymmetrical and irregularly contracted, as the ischiac and pubic rami on the diseased side are pushed inward upon the pelvic canal and over toward the healthy side (Pl. 29, Figs. 7, 8).

Etiology.—The cause of the obliquely-contracted pelvis under description is an absence of the bony nuclei in the ala or lateral process on one side of the sacrum. The lateral process consequently fails to develop, and the innominate bone is brought in relation with the bodies of the sacral vertebræ. As a result there must be some distortion of the innominate bone even in fetal and infantile life, but this is increased to an exaggerated degree when the individual begins to walk. Instead of receiving the pressure from the lower extremity approximately on the keystone of an arch, as does a normally-curved innominate bone, the deformed bone in a Naegele pelvis transmits the pressure in almost a straight line upward and backward, so that the extremity

of the posterior arm of the arch slides past the sacro-iliac joint instead of resting firmly on it as an arch does on its abutments. The irritation and strain of this unnatural movement bring about in time the atrophy and ankylosis of the joint.

That the deformity in this kind of oblique pelvis does not follow a primary ankylosis of the sacro-iliac joint is proven by the fact that the innominate bone is pushed backward and upward on the sacrum—a movement that would be impossible were this joint first ankylosed. As a further proof of primary lack of development and secondary ankylosis, there is no trace of inflammation in or about the ankylosed joint, and the alæ or transverse processes of the sacrum are atrophied or are absent along the whole length of the sacrum, and not only in that portion of it which enters into the composition of the sacro-iliac joint.

Diagnosis.—The recognition of an obliquely-contracted pelvis from arrested development of the sacral alæ may be very difficult. There is nothing to direct the attention of the physician to the possibility of this deformity. There is no history of previous disease or of accident, no scar of an old fistula over the joint, and the patient does not limp. The diagnosis can be made only by a methodical external and internal palpation of the pelvis and by careful measurements. If the outspread hands are laid over the innominate bones, it will be noticed that the dorsal surfaces are directed obliquely forward and backward as they lie upon the diseased and healthy sides. An internal palpation of the pelvis will detect one lateral wall much nearer the median line than the other, and the diagonal conjugate will be found to run not antero-posteriorly in direction, but from before backward and from the healthy to the diseased side of the pelvis. There are a number of points from which measurements may be taken that will show inequalities where in the normal pelvis the distances should be the same or should differ by a very small sum. Naegele recommended the following measurements: (1) The distance of the tuber ischii on one side from the posterior superior spinous process of the ilium on the other; (2) from the anterior superior spinous process of one ilium to the posterior superior spinous process of the other; (3) from the spinous process of the last lumbar vertebræ to the anterior superior spines of both ilia; (4) from the trochanter major of one side to the posterior superior spinous process of the opposite iliac bone; (5) from the lower edge of the symphysis pubis to the posterior superior spinous processes of the iliac bones. In addition to these measurements, others of value have been suggested by Michaelis and by Ritgen. These are the distances from the middle line of the spinal column to the posterior superior spinous processes of the iliac bones, and the distance from the lower edge of the symphysis to the ischiac spines, and from these spines to the nearest point on the edges of the sacrum. In this latter measurement it will be found that the distance from the symphysis to the ischiac spine is longest on the diseased and shortest on the healthy side, while the distance from the ischiac spine to the edge of the sacrum is very much shorter on the diseased than on the healthy side. This last, which is a very important meas-

urement, can easily be taken by laying finger-breadths between the points to be measured. An x-ray photograph often shows the deformity surprisingly well.

Influence on Labor.—The mechanism of labor in an obliquely-contracted pelvis is in the main that of labor in a generally-contracted pelvis. The shape of the pelvic entrance and canal is symmetrically ovoid, and the head can enter the contracted space only by extreme flexion. There are none of those anomalies of position, flexion, and inclination of the head which are seen in the flat pelvis. As the head descends the birth-canal anomalies of mechanism may appear resembling those described in the narrow, funnel-shaped pelvis—namely, abnormal and imperfect rotation and anomalies of flexion. Depending upon the degree of deformity, there is more or less interference with the progress of labor to complete obstruction. The head can almost invariably be found entering the pelvis and passing through the canal with its longest diameter in coincidence with the longest oblique diameter of the pelvis, from the diseased sacro-iliac joint to the opposite ilio-pectineal eminence.

Prognosis.—In the recorded cases the results of labor in the Naegele pelvis have been bad. Of 28 women reported by Litzmann, twenty-two died in their first labor, five of them undelivered. Three of these women died in consequence of their second labor, and two after the sixth. Out of 41 cases, six were delivered spontaneously, twelve by the forceps, fourteen by craniotomy, five by version and extraction, four by premature labor, and two by Cesarean section. The following accidents were noted in the course of labor or shortly afterward: Rupture of the uterus or vagina, vesico-vaginal fistula, fracture of the horizontal ramus of the pubis, rupture of the sacro-iliac joint and of the symphysis. In another series of cases, 28 women furnished 42 labors with the following results: twenty-one died as the result of the first labor, three of the second, and one after the sixth. These women were delivered seven times by craniotomy, once by Cesarean section, four times by premature labor, and in a number of instances by forceps. Out of 41 children in Litzmann's statistics there were only ten delivered alive, two of these by Cesarean section and two by premature labor. The six other living children were all born of the same mother.*

Treatment.—Forceps and version are not, as a rule, successful in the treatment of labor obstructed by an obliquely-contracted pelvis unless the degree of deformity is slight. The induction of premature labor and the performance of Cesarean section are the most successful means of delivery, but the former should be resorted to only when the distance between the lower edge of the symphysis pubis and the sacro-iliac joint of the healthy side is not under 8.5 centimeters. In 20 forceps operations thirteen women died. The proposition of Pinard to do what he calls ischio-pubiotomy has not met with much favor. The room gained by the movement outward of the innominate bone on the healthy side, the other being, of course, immovable, will be sufficient only in pelves so slightly contracted as to allow a delivery by much simpler means.

* The writer is indebted for these statistics to Schauta (*loc. cit.*).

C. v. 9¼ cm.
Tr. (inlet) 8 cm.

1

Tr. (outlet) 5 cm.

2

3

4

5

6

C. v. 5¼ cm.
Effec. tr. diam. 11 cm.

7

C. v. 4 cm.

8

1. Transversely-contracted pelvis (Robert; model in Mütter Museum, College of Physicians, Philadelphia). 2. Transversely-contracted pelvis, showing contraction at outlet (model in the Hirst Collection, University of Pennsylvania). 3. Transversely-contracted pelvis, with absence of sacrum (Hohl). 4. Split pelvis (Schauta). 5. Generally equally-contracted rachitic pelvis (Hirst Collection, University of Pennsylvania). 6. Generally-contracted rachitic pelvis (Hirst Collection, University of Pennsylvania). 7. Typical flat rachitic pelvis (Mütter Museum, College of Physicians). The promontory of the sacrum projects so far forward that the true transverse diameter is bisected by it. 8. Flat rachitic pelvis, with unusual descent of the promontory, rotation of the sacrum, and lordosis (Mütter Museum, College of Physicians).

Transversely-contracted Pelvis the Result of Imperfect Development of both Sacral Alæ.—This pelvis was first described in 1842 by Robert, and is generally known as the "Robert pelvis" (Pl. 30, Figs. 1, 2). It is the rarest of all contracted pelves. Schauta was able to find but six examples recorded in childbearing women. Ferruta has recently reported another case.[10] Herman gives eight as the number of recorded cases. The anatomical conditions are the same as in the Naegele pelvis, except that both sides of the sacrum are affected instead of one. Other parts of the sacrum besides the alæ may show imperfect development. There is a case reported in which the whole lower portion of the bone was absent (Pl. 30, Fig. 3). The sacrum in this pelvis is extremely narrow, and the posterior superior spinous processes of the iliac bones are brought close together. The degree of contraction in the transverse diameter is so extreme that natural labor is out of the question. An asymmetry of the Robert pelvis has been observed, one side showing a greater degree of the deformity than the other, and thus approaching the type of an obliquely-contracted pelvis.

The *cause* of this deformity is an absence of the bony nuclei in the sacral alæ of both sides. Secondarily, as in the Naegele pelvis, there is apt to be an ankylosis of the sacro-iliac joints. That this ankylosis is secondary and not primary is demonstrated by the same condition which proves that ankylosis is not a primary cause of the oblique contraction and ill-development of one side in the Naegele pelvis—namely, a displacement of the ilia on the sacrum necessarily occurring before the ankylosis.

The *treatment* of labor obstructed by a transversely contracted pelvis of this kind is Cesarean section.

Justo-major Pelvis.—A generally equally-enlarged pelvis may be found in women of gigantic stature, but it may also be demonstrated in a woman of medium height. The pelvis of the Nova Scotian giantess was large enough to give passage to a child weighing $28\frac{3}{4}$ pounds. The largest pelvis that has ever come under the writer's notice was found in a woman somewhat below the average height, without an abnormally great development of any other portion of her frame.

Diagnosis.—The diagnosis of a justo-major pelvis is made mainly by external measurements. If all of them are found far in excess of the normal while preserving their normal relative proportion, the diagnosis of a justo-major pelvis is justifiable. The internal examination, if considered necessary, will show that the promontory is quite inaccessible, and that it is much more difficult than common to reach the lateral pelvic walls. This anomaly of the pelvis does not, of course, obstruct labor; on the contrary, it predisposes to precipitate delivery, although the resistance of the soft parts may be quite sufficient to delay the process considerably, even though the pelvis present no obstacle whatever. During pregnancy it is noted that the uterus has a tendency to sink deep within the pelvic canal, so that pressure-symptoms of the pelvic viscera and blood-vessels are common in the latter weeks of gestation, and these symptoms may become so exaggerated as to make locomotion diffi-

cult. In labor there may be noted anomalies in the mechanism dependent upon insufficient resistance to the engagement of the head. Thus imperfect flexion at the superior strait may be observed, and there may be a tardy rotation of the head on the pelvic floor.

Split Pelvis.—The split pelvis, which is due to a defect in the development of the lower portion of the trunk in front, is almost invariably associated with exstrophy of the bladder. This pelvis has very rarely been observed in the childbearing woman; there are on record but seven examples complicating labor. This form of pelvis presents no obstacle in parturition. There are the same peculiarities in labor as in the justo-major pelvis—namely, a tendency to precipitate birth, and anomalies in the mechanism the result of imperfect resistance. After labor it is almost certain that there will be a prolapse of the uterus. The *diagnosis* of this deformity presents no difficulties, and no obstetric treatment is called for in labor (Pl. 30, Fig. 4).

The Rachitic Pelvis.—In the healthy life and growth of bones two opposed processes are found: on the periphery there is an active proliferation of cells to form the bone-structure, while in the interior, bone-substance is being constantly absorbed by the marrow. In rachitis the absorption of bone-substance goes on more rapidly than it does in healthy bone, and at the same time there is in the periphery a very much more rapid proliferation of cells, which do not, however, develop normal bone-structure. Their growth and multiplication result in the formation of an osteoid material poor in lime-salts and much more pliable than healthy bone. The result of this pathological process in the pelvic bones is to make the pelvis more sensitive than it should be to the mechanical forces that are brought to bear upon it.

In the rachitic pelvis the size and shape of the pelvic canal are modified by three factors: the pressure from the trunk above and the counter-pressure from the extremities below; the pull on the pelvic bones by ligaments and muscles; and an arrested development the consequence of an interference with normal growth that this disease occasions.

Characteristics—The effect upon the shape and size of the pelvic canal of rachitis in the pelvic bones is not uniform. Several varieties of contracted pelvis may result. The commonest is the flat pelvis with some contraction of all the diameters, but a most marked diminution in the antero-posterior diameter (Pl. 30, Fig. 7). There may, in addition to this common form, be found a simple flat rachitic pelvis without alteration of the transverse diameters, a generally equally-contracted rachitic pelvis (Pl. 30, Figs. 5, 6), and a so-called "pseudo-osteomalacic" pelvis, in which the effect seen in osteomalacia is produced by pressure upon the bones softened by rachitis. There are other rare forms of asymmetrical development, in connection usually with spinal disease of rachitic origin, that will be described elsewhere.

Characteristics of the Flat, Generally-contracted Rachitic Pelvis.—The sacrum is pressed forward and downward between the iliac bones, and is rotated on its transverse axis, mainly by the pressure of the trunk upon it, but partly by the pull downward of the psoas muscles upon the spinal column

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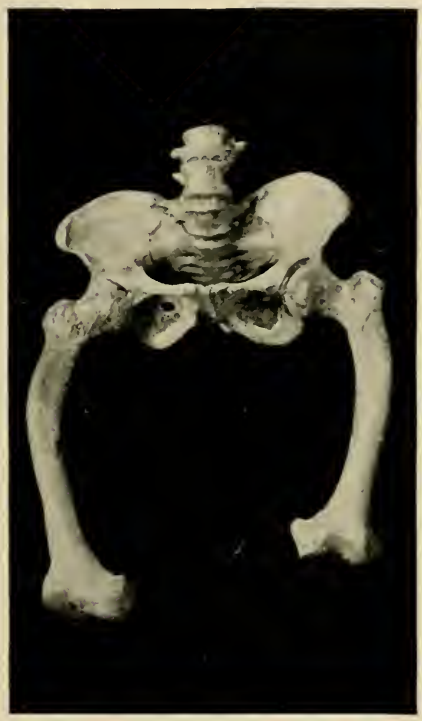
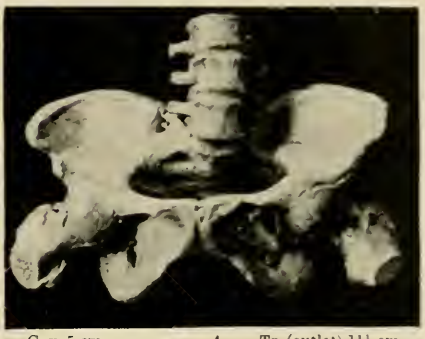
C. v. 7¾ cm. 2 Tr. 11¾ cm.



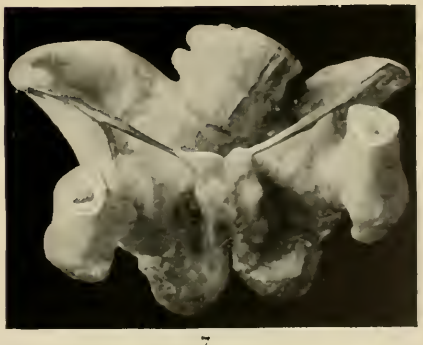
C. v. 5 cm. 3 Tr. 12¼ cm.



C. v. 5 cm.
Tr. (inlet) 11 cm. 4 Tr. (outlet) 11¼ cm.

5

6



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1. Flat rachitic pelvis, showing anterior position of acetabula (Mütter Museum, College of Physicians, Philadelphia). 2. Flat rachitic pelvis, showing relative measurements of antero-posterior and transverse diameters at inlet (Mütter Museum, College of Physicians). 3. Flat rachitic pelvis with bowed femora (Mütter Museum, College of Physicians). 4. Flat rachitic pelvis, showing relative measurements of inlet and outlet (Mütter Museum, College of Physicians). 5–7. Pseudo-osteomalacia.

and the pull upward upon the posterior surface of the sacrum by the erectores spinæ muscles (Pl. 30, Fig. 8). The effect of this movement would naturally be to throw the tip of the sacrum and the coccyx directly backward, so that the posterior surface of the sacral bone would run an almost horizontal course as the woman stood upon her feet. The attachments of the sacro-sciatic ligaments and muscles to the lower sacrum and coccyx, however, prevent this backward movement of the bone as a whole, and, pulling the lower portion of the bone forward, cause a sharp bend in it, usually at the junction of the fourth and fifth sacral vertebræ. The sacrum is narrowed in its transverse diameter, and the lateral concavity of the anterior surface is effaced, by the forward movement of the bodies of the vertebræ between the alæ. The anterior surface of the sacrum, indeed, may be convex from side to side. By the pull of the strong sacro-iliac ligaments running from the sacrum to the posterior superior spinous processes of the iliac bones the latter are pulled downward and forward by the descent of the sacral promontory, and are consequently made to approach one another behind, but they do not keep pace with the movements of the sacrum, and consequently project more prominently than common on either side. The natural result of this movement forward and inward on the part of the posterior superior portions of the ilia would be to throw the anterior half of the innominate bones outward, but this movement is opposed by their junction at the symphysis, and to a less degree by the attachment of Poupart's ligament to their anterior superior spinous processes. The ilia, however, restrained by a somewhat yielding force, are thrown to a certain degree outward and backward, so that their upper edges run almost horizontally outward, and the distance between their anterior spines becomes little less than, the same as, or even greater than, the distance between their crests (Pl. 30, Fig. 7). A further result of these combined forces pulling the innominate bones inward and forward behind and holding them in place in front is to produce in them an abnormal curvature, as in the case of the sacrum, or as in a bow bent between one's hand and the ground (Pl. 31, Figs. 3, 4). The point of angulation or greatest curvature is found on the ilio-pectineal line, back of the median transverse line of the pelvic inlet, near the sacro-iliac joints. On account of the flexion of the innominate bones the transverse diameter of the rachitic pelvis is relatively increased, but as the whole pelvis is commonly below the normal in size, this diameter rarely exceeds, if, indeed, it equals, the normal transverse measurement. A further consequence of the exaggerated curvature of the innominate bones is to throw the acetabula forward, so that the counter-pressure of the lower extremities is exerted more antero-posteriorly than in the normal pelvis (Pl. 31, Fig. 1). The pubic rami and the symphysis are diminished in height and show a lessened slant outward. The cartilage at the junction of the symphysis projects inward upon the pelvic canal, standing out above the level of the bones to such a degree that it is sometimes a source of injury to the head or to the maternal structures. The force of resistance at the symphyses to the outward movement of the innominate bones sometimes bends the ends of the

pubic bones inward upon the pelvic canal, giving to the pelvic inlet the shape of a figure 8. From the traction of the adductor and rotator muscles of the thigh upon the tuberosities of the ischiac bones (increased in rachitis by the positions of the acetabula and the bowing of the femora), the latter are pulled outward and forward so that the pubic arch is greatly widened and the transverse diameter of the pelvic outlet is increased (Pl. 31, Fig. 4). The antero-posterior diameter of the outlet is somewhat diminished by the excessive perpendicular curvature of the sacrum, but the contraction is relatively much less than in the conjugate of the inlet. The whole pelvis is tilted forward on its transverse axis, so that the inclination of the superior strait is increased and the external genitalia are displaced backward.

The bones of a rachitic pelvis are usually slighter and more brittle than common. They may, perhaps, show no peculiarities in structure, or in rare cases they may be found much thicker and heavier than normal.

In the generally equally-contracted rachitic pelvis—a rare type—is seen mainly an arrest of development, the consequence of rachitis in very early life, which retarded growth without much affecting the shape of the pelvic inlet and canal, from the fact that the pelvis had not been subjected to the pressure of the trunk during the active stage of the disease, because it ran its course to complete recovery before the child attempted to sit up or to walk. Possibly also the disease in some of these cases is not severe and lasts but a short time. As the deformity is the result of arrested development, we find a transverse contraction as in the fetal ill-developed pelvis (Pl. 30, Figs. 5, 6).

The *diagnosis* of the rachitic origin of this type of pelvis is made by the relations of iliac spines to crests, by the history of rachitis in early infancy perhaps, and possibly by the signs of the disease in other portions of the body.

In the *pseudo-osteomalacic pelvis* the rachitis has been severe in character and long continued. Efforts to walk have been made while the disease was in active progress, and possibly the weight of the trunk has been exaggerated by attempts to carry heavy burdens. As a consequence of the pressure of the trunk and the counter-pressure of the lower extremities the pelvis bends to an extreme degree under the forces imposed upon it. The sacrum sinks far down into the pelvic canal and is sharply curved or bent from above downward; the innominate bones are bent at a sharp angle laterally, and the acetabula are pressed inward upon the pelvic canal. When at length the bone disease has run its course the pelvis is firmly set, by the hardening of the bones, in its unnatural position and shape. The differential diagnosis between this pelvis and the true osteomalacic pelvis is made by the direction of the iliac crests, by the firm constitution of the bones after the disease has been arrested, and by the signs of rachitis in other portions of the body. Osteomalacia, besides, has certain peculiarities of its own that enable one to recognize it without difficulty (Pl. 31, Figs. 5, 6, 7; Pl. 32, Fig. 1).

Diagnosis.—The diagnosis of a rachitic pelvis is made by external and internal measurements, by palpation of the exterior and interior of the pelvis, by the woman's history, and by her appearance. An individual who has had

1

C. v. 8 cm.
2d sac. vert. to sym. 5½ cm.

2

3d sac. vert. to sym. 4½ cm. Tr. 11½ cm.

3

C. v. from 1st and from 2d sac. vert. 6½ cm.

4

Tr. 12½ cm.

5

6

7

1. Pseudo-osteomalacia. 2. Rachitic pelvis with contracted antero-posterior diameter throughout the pelvic canal (Mütter Museum, College of Physicians, Philadelphia). 3. Pendulous belly of rachitis (Charpentier). 4. Rachitic pelvis with double promontory (Mütter Museum, College of Physicians). 5, 6. Minor grades of osteomalacic pelves. 7. Osteomalacia, showing asymmetrical contraction at outlet.

rachitis in childhood is usually of small stature, with short, thick, curved extremities, a low broad brow, a large square head, a flat nose, a "chicken breast," and enlarged joints. The lumbar lordosis and the rotation of the sacrum produce a sway-back, most noticeable when the woman lies on her back upon a hard surface. When she stands erect the pregnant uterus near term falls abnormally forward and downward, on account of the short abdomen and lack of engagement of the presenting part (Pl. 32, Fig. 3). The most characteristic facts in her history are that she walked first at three or four years of age and was late in getting her teeth. By the pelvimeter the normal relation between the iliac spines and crests is found disturbed. The difference in distances between the former and between the latter is much reduced. The posterior superior spinous processes are approximated, and the

FIG. 24.—Appearance during life of the highest grade of rachitis: pseudo-osteomalacia (Pippingskjöld).

FIG. 25.—Skeleton of a rachitic dwarf (Medical Museum, University of Pennsylvania).

depression under the last spinous process of the lumbar vertebra approaches or is actually in the line drawn between them. The external antero-posterior diameter of Baudelocque is below the normal. Internally, the diagonal conjugate is found considerably reduced. The symphysis has less of a slant outward than it should have, the promontory is found low and prominent, the sacral bone is sharply bent upon itself, and the pelvic canal is remarkably shallow. On account of the increase in the conjugate-symphyseal angle due to the lessened slant outward of the symphysis, at least 2 centimeters should be subtracted from the diagonal conjugate. The difference between the two would be greater were it not for the low situation of the promontory, which compensates to a certain extent for the lessened slant of the symphysis, but does not entirely neutralize it. A double promontory in these pelves is not

uncommon (Pl. 32, Figs. 2, 4). If found, the measurement should be taken from the promontory nearest the symphysis. Occasionally the lordosis of the lumbar vertebræ, the result of spinal rachitis, is so great as to constitute itself an obstruction above the pelvic inlet. In such a case the effective conjugate must be taken from a point above the sacrum to the symphysis pubis (Pl. 30, Fig. 8).

Influence on Labor.—The influence on labor of a flat rachitic pelvis is much the same as the influence of a simple flat pelvis, except that the contraction, and consequently the obstruction to labor, is greater in the rachitic form, and that the promontory of the sacrum is more prominent and more sharply defined. The anomalies of mechanism at the inlet are the same in both forms of pelvis, but they are exaggerated in the flat rachitic pelvis. As soon as the obstruction at the inlet is overcome the descent of the head and its escape is more rapid in the rachitic pelvis, because of the shallow canal and the expanded

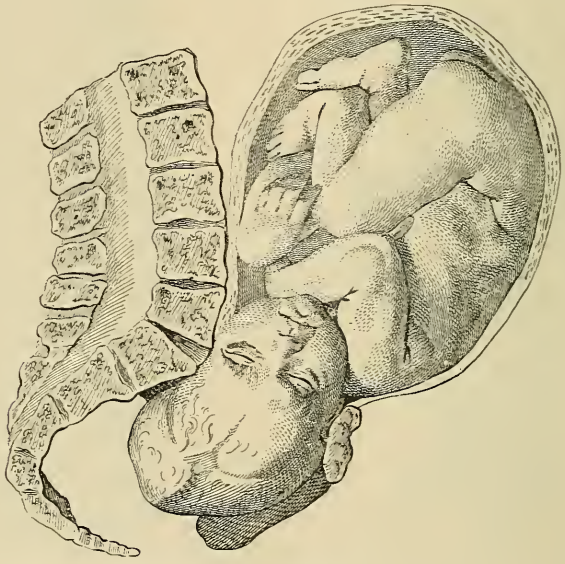

FIG. 26.—Pressure of the promontory upon the head in a contracted pelvis (Smellie).

outlet. Injuries to the child's head and to the maternal tissues from pressure are common. In the former a sharp indentation may be seen on that portion pressed against the promontory in the efforts to secure engagement (the so-called "spoon-shaped" depression, with fracture of the parietal bone; Figs. 22, 26, 27). Localized necroses are not infrequently seen in the maternal structures where they have been nipped between the child's head and prominent portions of the pelvic bones—namely, in the cervical tissues over the promontory, or very rarely in the posterior vaginal vault, and in the anterior vaginal wall behind the symphysis and the ridge of the pubic bones. When the slough separates openings may be established between the birth-canal and the peritoneal cavity, the bowel, the bladder, and a ureter.

Osteomalacic Pelvis.—Osteomalacia, a soft condition of the bones in consequence of an osteomyelitis and an osteitis, is exceedingly rare in

America. There are certain parts of the world where it is frequently seen, notably Italy, Germany, and Austria, but in America there are but three or four examples on record. The bones of the pelvis in this disease become so soft that they yield to every force imposed upon them. They bend before the pressure of the trunk from above, the extremities from below, and the pull of the muscles attached to the pelvic bones. The flexibility of the pelvis in extreme cases of osteomalacia can be appreciated when it is stated that the superior iliac spines may be bent backward until they touch the spinal column; the horizontal rami of the pubis may be pushed inward until they almost obliterate the pelvic inlet; and the tuberosities of the ischium may be approximated until they nearly close the pelvic outlet. Not only are the pelvic walls so compressed that they almost obliterate the pelvic canal, but the spinal column also, sinking under the weight of the trunk, bends far forward

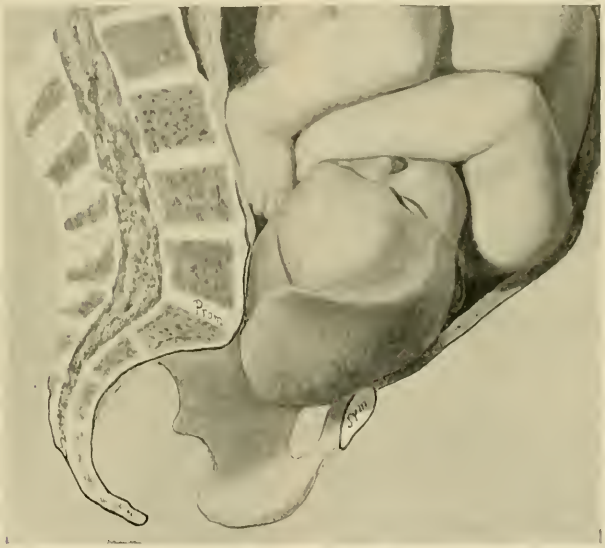

FIG. 27.—Overlapping of the cranial bones in a futile attempt to engage in the superior strait of a rachitic pelvis (Smellie).

and descends low into the pelvis, occupying the little remaining room in the inlet and canal, and becoming itself a serious obstruction to the engagement of the presenting part. From the lateral pressure of the thigh-bones the ischia and pubes are pushed inward and backward, making by the former movement a sharp beak-like projection of the pelvic inlet between the pubic rami, and by the latter much diminishing the size of the pelvic canal (Pl. 32, Figs. 5, 6, 7). The sacrum is rotated on its transverse axis and is driven low into the pelvic canal—an exaggeration of the movement seen in a rachitic pelvis. The lower portion of the sacrum and the coccyx are pulled sharply forward by the muscles attached to them, so that the sacrum is bent at a sharp angle in its lower third. The innominate bones are bent laterally at a point slightly anterior to the sacro-iliac junction, and the iliac bones may be folded upon themselves horizontally. The inclination of the pelvis as a whole is much increased.

The diagnosis may be based upon the following symptoms: The disease begins usually during pregnancy or lactation, with dull aching pains in the extremities, the back, the lumbar region, and over the anterior portion of the pelvis. Every movement increases these pains. As the disease progresses the bones of the spinal column are so bent and compressed that the individual is diminished in stature to an extraordinary degree. She may lose as much as

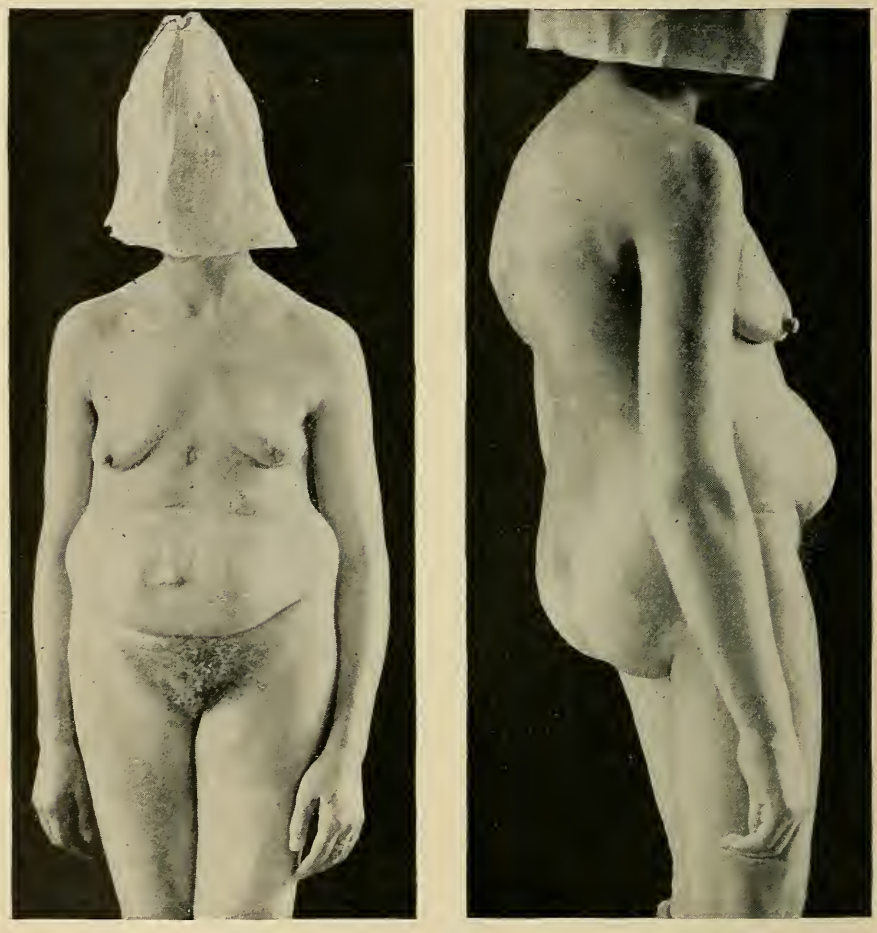

FIG. 28.—Hirst's case of osteomalacia (front and profile views in different perspective).

a foot and a half in height (Fig. 28). The gait of an osteomalacic patient is peculiar. In order to compensate for the approximation of the thighs brought about by the collapse of the pelvis the individual must turn almost through a half circle in order to bring one foot in front of the other. Upon examination of the pelvis tenderness upon pressure is discovered over its anterior wall. The flexibility of the pelvic bones may be demonstrated by direct pressure, and an

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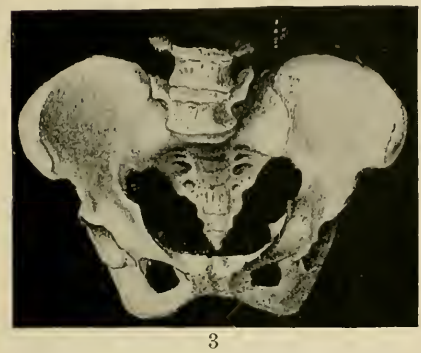

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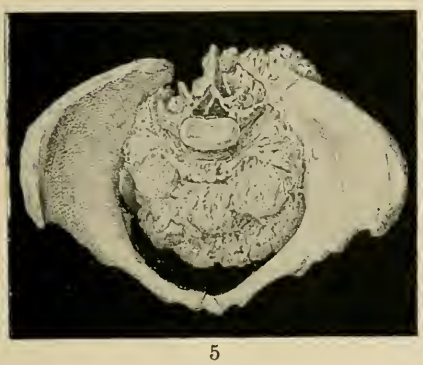

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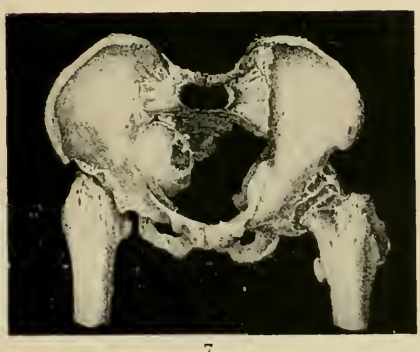

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1. Exostoses at the sacro-iliac junctions. 2. Knob-like exostosis on the promontory (Schauta). 3. Acanthopelys. 4. Rachitic pelvis with abnormal but blunt projection of ileo-pectineal eminences (Mütter Museum, College of Physicians, Philadelphia). 5. Enchondroma (Behm). 6. Fracture of the pelvis (Otto). 7. Fracture of the acetabula in consequence of coxalgia (Otto). 8. Fracture of the right ala of the sacrum (Fritsch).

internal examination discovers in the early stage of the disease the peculiar beak-like space behind the symphysis, and later the almost entire obliteration of the pelvic outlet and canal by the sinking in of the pelvic walls. If it is possible to make a satisfactory internal examination of the pelvis, the low position and the projection of the promontory at once attract attention, and the sharp angulation on the anterior face of the sacrum can be felt. On account of the exaggerated inclination of the pelvis it may be necessary to make an examination with the patient upon her side. An osteomalacic pelvis has been taken for a kyphotic, a Robert, a pseudo-osteomalacic, a cancerous, or a fractured pelvis, but a careful, methodical examination of the patient will always lead to a correct diagnosis.

Influence upon Labor.—The results of labor in osteomalacic pelves show

FIG. 29.—Cystic enchondroma (Zweifel).

FIG. 30.—Button-like exostosis on the promontory (Schauta).

that the obstruction is a serious one in spite of the flexibility of the pelvic bones, by reason of which flexibility in some cases the head can distend the pelvic canal sufficiently to pass through. In 85 cases collected by Litzmann forty-seven ended fatally. In another series of 128 cases the labor had a spontaneous termination in twenty-seven cases, in four there was premature delivery, and in five abortion; four times the labor was naturally terminated; in eight cases version was performed, in four the child was extracted by the feet, in twenty-five forceps was employed, in eleven craniotomy was performed, and in thirty-six Cesarean section; rupture of the uterus occurred in five women before any operation was undertaken. In still another series of cases reported from Milan the flexibility of the pelvis was so great that the child was delivered in only two instances by Cesarean section. The most successful

treatment is Cesarean section, and the operator should at the same time remove the ovaries, or, what is better, do a complete Porro operation. It is beyond dispute that the cessation of sexual functions favorably modifies or actually cures the disease.

Tumors of the Pelvis.—The commonest pelvic tumors are bony excrescences, usually found over one of the pelvic joints. The excrescences are originally cartilaginous projections which become ossified by an extension of bony tissue from the two bones between which they lie. These exostoses may be found over the sacro-iliac joints, over the symphysis pubis, and over the promontory of the sacrum (Figs. 30, 31; Pl. 33, Figs. 1, 2). They may attain the size of a pigeon's egg, though they are usually not larger than a pea or a nut. In the exostoses occupying the seat of the pubo-iliac junction, directly above the acetabula, the bony growth is apt to assume a sharp, thorny shape, projecting with its point into the pelvic inlet. Kilian was the first to direct attention to this fact; he called a pelvis thus deformed "*acanthopelys*" (Pl. 33, Fig. 3), or a "*pelvis spinosa.*" Another possible seat for a bony projection is along the crests of the pubic bones, the exostosis taking here the form of a long, sharp edge, and probably owing its origin to an ossification of the attachment of the iliac fascia, a transformation of tissue analogous to the ossification sometimes seen in Gimbernat's ligament. These bony outgrowths constitute a serious form of obstruction in labor, not so much from their encroachment upon the room of the pelvic inlet as from the sharply-localized pressure which they exercise upon the maternal structures and upon the fetal head. In the four cases reported by Kilian, death, it was claimed, resulted in each case from a perforated uterus. Other tumors of the pelvis offering an obstruction in labor are enchondromata, fibromata, sarcomata, carcinomata, and cysts (Fig. 29; Pl. 33, Fig. 5). These tumors are rare, and their importance as an obstacle in labor depends, of course, upon their size. Cysts of the pelvis are formed usually in sarcomata and in enchondromata, or are hydatid cysts. Cancer of the pelvic bones is always a secondary growth or is metastatic. It may result in a number of small tumors in the bony pelvic walls, or may take on the form of cancerous infiltration with a consequent softening of the bones like that of osteomalacia. The treatment of labor obstructed by tumors of the pelvis is ordinarily Cesarean section. There is one case on record (Abernethy's) in which the tumor, an enchondroma, was removed by an incision in the posterior vaginal wall, but in the vast majority of cases these growths cannot be reached or cannot safely be excised. In 49 cases of labor obstructed by a pelvic tumor 50 per cent. of the women and 90 per cent. of the children lost their lives (Winckel).

FIG. 31.—Exostosis on the symphysis (Schauta).

Fractures of the Pelvis.—Out of 13,200 fractures reported from nine

large hospitals in America and in Europe, but 0.8 of one per cent. were fractures of the pelvis. When one considers that almost all grave injuries of the pelvis end fatally, the rarity of a pelvic deformity dependent upon a united fracture of a pelvic bone in a woman of childbearing age may be appreciated. Most frequently the fracture is found in the pubes, next in the ilium, next in the ischium, next in the acetabulum, and least frequently of all in the sacrum. The effect of a fracture of the pelvis upon the shape and size of its canal depends on the situation of the fracture, and may be due to distortion of the pelvic walls, to excessive callus-formation, or to ossification of the pelvic joints nearest the seat of fracture. In a fracture of the acetabulum the result of hip-joint disease the head of the femur may project into the pelvic canal (Pl. 33, Fig. 7). Fracture of the pubes results in an irregular distortion of the pelvic inlet, most marked, of course, on the injured side (Pl. 33, Fig. 6). A fracture of the upper portion of the sacrum may result in a spondylolisthetic deformity (Fig. 32). Fracture of the lower portion of the sacrum is followed by a dislocation of the lower fragment inward. In a case seen by the writer the lower half of the sacral bone was turned in at right angles to the rest of the bone by the pull of the pelvic muscles attached to it. A fracture of the sacral alæ may cause an oblique contraction of the pelvic inlet like that of the Naegele pelvis Pl. 33, Fig. 8). Neugebauer[11] reported an extraordinary case of bilateral fracture of the pubic rami in which there was union with callus-formation on one side and an ununited fracture on the other, the fragments moving on one another 2 or 3 centimeters when the woman walked.

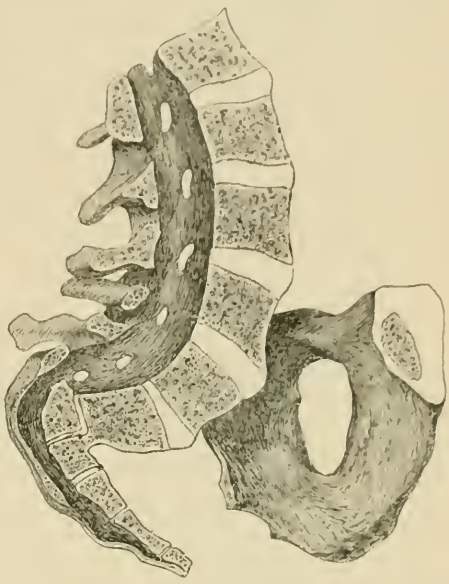


FIG. 32.—Transverse fracture of the sacrum with spondylolisthetic deformity (Neugebauer).

Caries and Necrosis.—The only effect of this disease of the pelvic bones is the production, in rare cases of tuberculosis of a sacro-iliac joint, of an oblique contraction of the pelvis. When the sacro-iliac joint is affected the ultimate result is the same as that produced by imperfect development of the sacral alæ in a true Naegele pelvis. There is loss of tissue, ankylosis of the joint, and an arrest of development in the affected part if the disease occurs in early childhood.

Ankylosis and Relaxation of the Pelvic Joints.—Synostosis may develop in any of the pelvic joints; in the symphysis it occurs not infrequently, and often at an early age. A number of operators have encountered this difficulty in attempts recently to perform symphysiotomy. In otherwise unob-

structed labor synostosis of the pubic symphysis is not a serious condition, although it limits the slight expansion which every normal pelvis should exhibit preparatory to and during labor.

If synostosis of the sacro-iliac joint develops in the individual's early childhood, it is followed by ill development of the sacral alæ on the affected side, and of that portion of the innominate bone concerned in the formation of the joint, an obliquely-contracted pelvis of the Naegele type being the result; but such cases are rarer than those in which lack of development in the sacral alæ is the primary occurrence. If the synostosis of the joint occurs after puberty, the effect upon the pelvis and upon the course of labor is practically *nil*. If both joints are early ankylosed, a form of laterally-contracted pelvis like the Robert pelvis is the result. This kind of contracted pelvis is rarer than the transversely-contracted pelvis due primarily to lack of development in the sacral alæ.

The sacro-coccygeal joint becomes ankylosed, as a rule, between the thirtieth and fortieth years, but as the joint between the first and second coccygeal vertebræ is ordinarily unaffected, the pelvic outlet is capable of expansion during labor in its antero-posterior diameter nearly as well as if the sacro-coccygeal joint were normal. Rarely there is an ankylosis of all the coccygeal joints along with that between the sacrum and the coccyx. In these cases labor can be terminated only by a fracture of the coccyx or a rupture of a sacro-coccygeal joint, usually the first. The expulsive forces of labor may be sufficient to cause this fracture, and the bone has been heard to give way with a loud crack as the head was passing through the pelvic outlet. This accident, however, is more likely to be caused by the artificial extraction of the head.

An abnormal relaxation of the pelvic joints may be a simple exaggeration of that natural process by which the pelvic canal is made somewhat expansible preparatory to labor. It is more likely, however, to be due to some pathological condition within the pelvic joints, as an inflammatory process followed, perhaps, by suppuration, the collection of fluid within the joint, osteomalacia, caries, or new growths. In pregnancy the pathological relaxation of the pelvic joints may occasion some difficulty in locomotion. During labor an exaggerated relaxation of the joints predisposes to their rupture.

The Spondylolisthetic Pelvis.—The spondylolisthetic pelvis was first described in 1839 by Rokitansky, who reported two cases; Kiwisch and Kilian followed with a description each of a specimen; but we owe our knowledge of the condition mainly to the indefatigable researches of Neugebauer,[12] who collected more than ninety cases and specimens, and to the discoveries of Lane, who has done much to clear up the etiology. The name "spondylolisthesis" * indicates the condition—a slipping down or dislocation of the vertebræ. To affect the pelvis the spondylolisthesis must be in the lumbo-sacral region (Figs. 33–35).

Characteristics—As the name denotes, there is a dislocation of the last

* σπόνδυλος, vertebra, and ὀλίσθησις, a slipping out or down.

lumbar vertebra in front of the sacrum, the body of the former slipping down in front of the first sacral vertebra, so that its inferior border, or in advanced cases its anterior surface, comes in contact with the anterior face of the sacrum, to which it becomes united by bony union. There is also, of necessity, an exaggerated lordosis of the lumbar vertebra and a descent into the pelvic inlet of at least the fourth and third, and even of the second, lumbar vertebræ, which diminish by their bulk and anterior projection the antero-posterior diameter of the pelvic canal. It is only the body of the last lumbar vertebra that is displaced, and not the arch, held fast by the lower posterior articular surfaces, nor the laminæ surrounding the spinal cord, so that the latter does not necessarily suffer compression by the displacement of the vertebræ, although this result has been noted in a few cases (Fig. 34). To allow the displacement of the body of the last lumbar vertebra the inter-

Fig. 33.—Spondylolisthesis, well marked (Schauta).

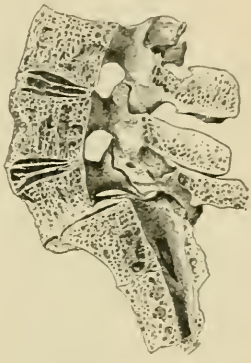


Fig. 34.—Spondylolisthesis, beginning (Schauta).

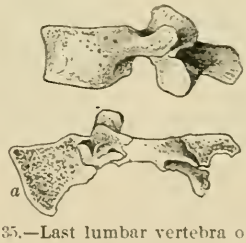


Fig. 35.—Last lumbar vertebra of spondylolisthesis (*a*) contrasted with a normal fifth lumbar vertebra (Neugebauer).

articular segment of the spinal arch and the pedicles are enormously lengthened from behind forward and are bent at an angle downward (Fig. 35). After a time this segment may exhibit a transverse fracture or a solution of continuity from pressure and attrition. The deformity is always gradual in development. If it develops during the childbearing period, successive labors become increasingly difficult. As the vertebra descends it pushes the sacrum backward and downward, and with it depresses the posterior portion of the pelvic brim. To compensate for this movement the anterior half of the pelvic brim rises and the height of the symphysis is increased. This movement of the pelvis diminishes very markedly its inclina-

tion, and disturbs the normal relationship between the bones and the soft structures that overlie them. The base of the triangle formed by the pubic hair in women is well below the upper edge of the symphysis, and the external genitalia are so pulled forward that the vulvar orifice is directed anteriorly as the patient sits or stands. There are, moreover, the same displacements of the pelvic bones that are seen in kyphosis—a rotation backward of the sacrum on its transverse axis, and a rotation outward of the upper portions, and inward of the lower portions, of the innominate bones on their antero-pos-

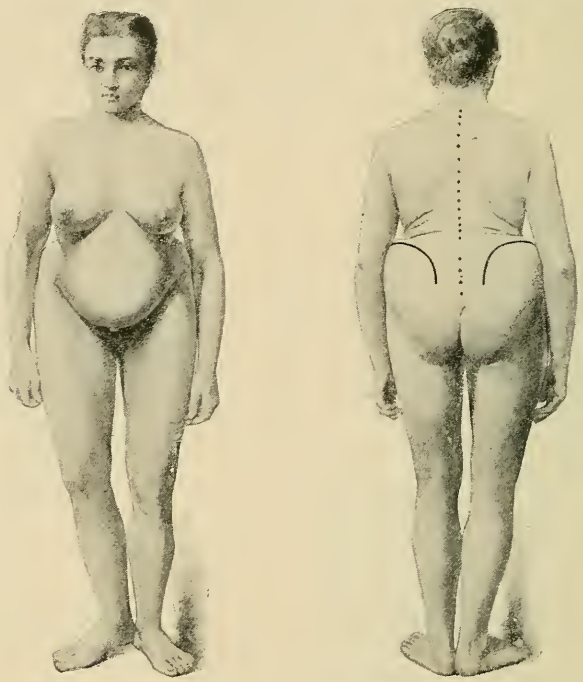


FIG. 36.—Winckel's case of spondylolisthesis of moderate degree.

terior axes. The descent of the lumbar vertebræ drags the large arteries of the lower trunk into the pelvic inlet, so that the iliac vessels and the bifurcation of the aorta can be felt in the vaginal examination. The degree of contraction in the conjugate diameter of the inlet depends upon the descent of the last lumbar vertebra and the degree of the lordosis. The contraction is usually not excessive, but it may be so great as to preclude the possibility of the engagement of the fetal head.

Etiology.—The etiology of spondylolisthesis at the lumbo-sacral junction is still involved in considerable obscurity. It has been attributed to direct injuries of, and to faults of development or ossification in, the interarticular segments of the spinal arch. It is certain that these are predisposing causes, but the observations of Lane appear to demonstrate that the commonest cause of this deformity is an exaggerated pressure from the trunk above exerted often upon healthy bone. As the result of this pressure a joint is formed in the intervertebral disk, and the interarticular segments of the last lumbar vertebra undergo stretching, pressure, angulation, and atrophy until the bone

is actually severed. Following or accompanying these changes in the arch, the body of the last lumbar vertebra is displaced farther and farther downward and forward.

Frequency.—Neugebauer has collected 115 cases, to which number Williams added 8. Of these 123 cases, 8 occurred in men.

Diagnosis.—The diagnosis of a spondylolisthetic pelvis is not easy, and can be made only by close attention to the patient's history, by a careful observation of her appearance, by an internal and external examination of the pelvis, and by pelvimetry. In the history of the case it may appear that the individual was the subject of a serious accident, such as a fall from a height or a fracture of the pelvis by the passage over it of a heavy weight, or it may be learned that she has carried excessively heavy burdens for a long time. The woman's height is diminished and the length of the abdomen is shortened. Viewing the patient from behind, there appears what is called the saddle-shaped or "sway" back, the lumbar vertebræ projecting visibly far forward

Fig. 37.—Ahlfeld's case of spondylolisthesis.

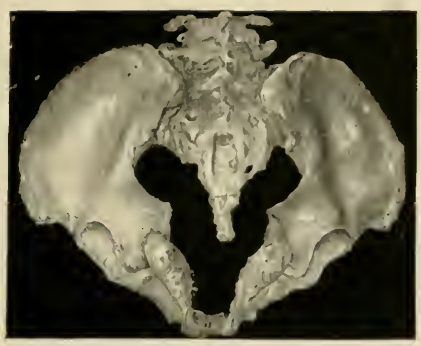
Fig. 38.—Breisky's case of spondylolisthesis.

and being displaced downward, throwing into bold relief the posterior superior spinous processes and the rims of the iliac bones, and producing quite a deep furrow along the course of the spinous processes of the lumbar vertebræ. The apposed articular processes of the first sacral and the last lumbar vertebræ stand out as button-shaped prominences on the inner surface of the posterior rims of the ilia. The buttocks are flat and are pointed below, giving to the region a cordiform appearance. In front there is a pendulous belly; a deep crease is observed running across the lower abdomen a short distance above the symphysis. Laterally, the floating ribs are seen almost to rest upon the crests of the ilia or actually to sink between them, and the soft structures of the flanks are thrown outward in prominent folds. The trunk is shortened, and the limbs appear relatively too long (Figs. 36–38). The patient's body being thrown forward by the deformity of the spine, an effort to maintain an equilibrium is made by carrying the shoulders far back; as the individual walks

a disposition to fall forward may be noted, and she will state perhaps that she is unable to carry any load upon her arms in front of her body, for fear of toppling over upon her face. She may also complain of a grating sensation and sound in the small of the back (crepitus). The gait is peculiar; the toes are not turned outward, and the feet are swung around one another so that the foot-prints fall in a straight line. Upon an internal examination of the pelvis—best conducted, according to Neugebauer, in an upright or lateral position—the lordosis of the lumbar vertebræ is at once discovered. The angle formed by the attachment of the last lumbar vertebra to the sacrum may be detected with ease, and it is noted that the body of this vertebra does not possess lateral projections, transverse processes, or alæ. By their absence one is sure that he is not feeling a projecting promontory. Pulsating iliac arteries can be felt, and it is possible even to reach the bifurcation of the aorta—a symptom first pointed out by Olshausen. But the symptom is not pathognomonic. The same sign is exhibited in the extreme lordosis of some rachitic pelves and of the osteomalacic pelvis, also in lumbo-sacral kyphosis and in some cases of dorso-lumbar kyphosis.

The external palpation of the pelvis reveals the absence of inclination. A measurement of the pelvis will show a marked diminution in the external conjugate diameter, an increased height in the symphysis pubis, an increased distance between the posterior superior iliac spines, and a diminished distance between the anterior iliac spines and the crests. There is also some diminution in the diameters of the outlet. The internal conjugate diameter must be measured from the lumbar vertebra nearest the symphysis pubis—usually the fourth. This is called the "false" or "effective" conjugate diameter of the spondylolisthetic pelvis. On account of the decreased inclination of the pelvis it is not necessary to subtract more than the ordinary sum from the diagonal conjugate. In fact, the diagonal conjugate may approach very nearly the length of the true, or may actually measure less than it.

Influence upon Labor.—The influence of a spondylolisthetic pelvis upon labor is that of a flat pelvis. The obstruction in the former may be overcome more easily on account of the bow-like shape of the projecting vertebra and the coincidence of the uterine and pelvic axes. The obstruction to labor depends entirely upon the projection of the lumbar vertebræ. This projection may be so slight as scarcely to influence the progress at all, or it may be so great as to make delivery by the natural channel quite impossible. There is noticed in labor something of the same mechanism that is seen in the flat pelvis for the purpose of overcoming the obstruction—namely, decreased flexion, transverse position, and exaggerated lateral inclination of the head. On account of the forward dislocation of the external genitalia and of the pelvic floor, lacerations of the latter are the rule, and the tears are often complete into the rectum. This liability to injury is explained by the fact that the presenting part impinges directly upon the middle of the pelvic floor as it descends the birth-canal, instead of being directed forward to the vulvar orifice. Fistulæ of the anterior vaginal wall are likewise common, from the



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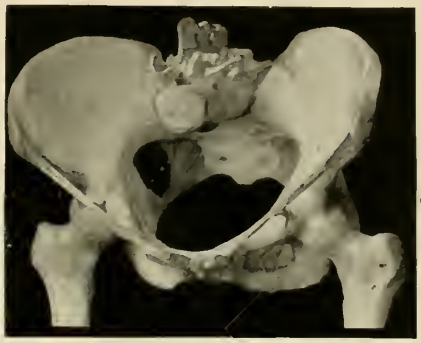

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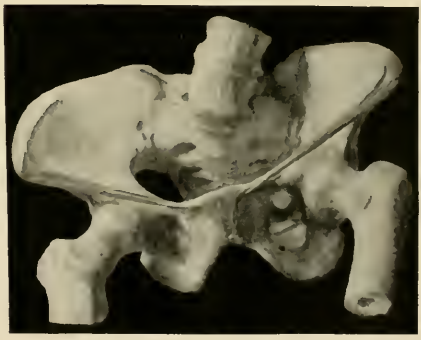

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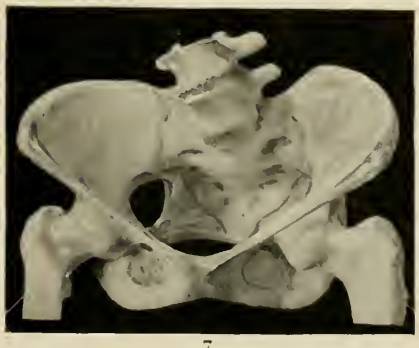

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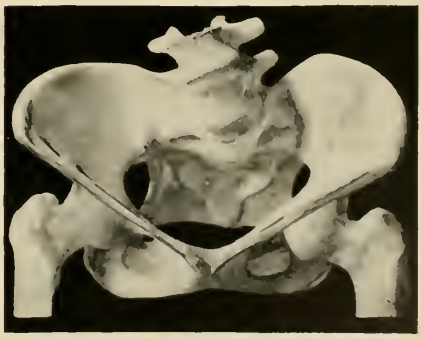

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1. Contracted outlet of a kyphotic pelvis (Barbour). 2. Kyphotic pelvis from above (Barbour). 3, 4. Lumbo-sacral kyphosis (pelvis obtecta). 5. Asymmetrical contraction of the outlet from kyphoscoliosis. 6–8. Types of scoliotic rachitic pelves.

localized pressure to which this region is subjected while the head is passing the obstruction at the inlet. The presenting part is thrown forward by the projecting vertebræ, and is received upon the prominent ridge of the pubic bone, greater in height and higher in situation than in the normal pelvis.

Treatment of Labor Obstructed by Spondylolisthetic Pelvis.—The management of labor in these cases is governed by the same principles that obtain in the management of labor in a flat pelvis. If the effective conjugate is over 9.5 centimeters, the woman can be delivered spontaneously, by forceps, or by version. With an effective conjugate of between 7 and 9.5 centimeters the induction of premature labor and the performance of symphysiotomy must be considered; or craniotomy should be done if the child is dead. If the effective conjugate is at or under 7 centimeters, delivery must be effected by a Cesarean section. These rules presuppose, of course, a child of average size.

Fig. 39.—Kyphosis: greatest transverse diameter at outlet, 7 cm. (Mütter Museum, College of Physicians, Philadelphia).

Kyphosis.—The kyphotic pelvis was first adequately described in 1865 by Breisky, although its peculiarities had been recognized before by Litzmann in 1861 and by Neugebauer in 1863. The condition was called by Herrgott "spondyl-izema," a name adopted by Neugebauer and others (Fig. 39; Pl. 34, Figs. 1, 2).

Characteristics.—The degree of deformity in a kyphotic pelvis depends upon the situation of the hump: the nearer this is to the sacrum, as a rule, the greater is the deformity in the pelvis. Ordinarily the kyphosis will be near the dorso-lumbar junction. There is a compensating lordosis of the lumbar spine, but not enough to keep the centre of gravity of the trunk from being too far forward. In consequence the weight of the trunk is transmitted in a direction from before backward, so that the sacrum is rotated on its transverse axis in a direction the reverse of that seen in rachitis—namely, backward and downward. The result of this movement is to make the sacrum straighter, narrower, more curved from side to side, and longer (Pl. 34, Fig. 2), to pull the posterior superior spinous processes of the iliac bones closer together, and to separate the anterior spines more widely. The diminished width between the posterior superior spinous processes is caused partly by the pull of the sacro-iliac ligaments. The sacrum cannot move in any direction without dragging the ilium on each side by these ligaments, thus approximating their upper posterior surfaces. It depends also upon the narrowness of the sacrum. To compensate for the movement of the upper portion of the sacrum backward, the lower portion of the bone projects forward into the pelvic outlet. To preserve the body from falling forward, the knees and thighs are slightly flexed and the pelvic inclination is almost entirely lost. This posture puts on a stretch the ilio-femoral liga-

ments, which pull outward the upper portions of the innominate bones. To compensate for the movement outward of the iliac bones, the lower segments of the innominate bones move inward upon the pelvic inlet; in other words,

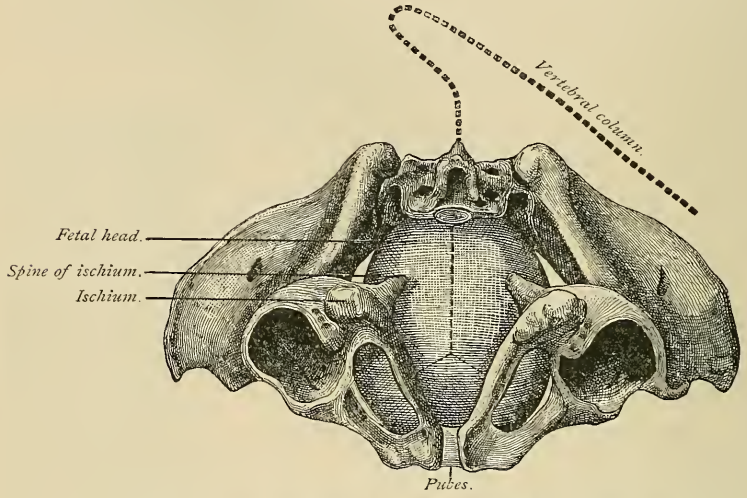

FIG. 40.—Head arrested by spines of ischia in a kyphotic pelvis (Budin).

there is a rotation of the innominate bones upon their antero-posterior axes. The result of these movements in the pelvic bones is to enlarge somewhat the pelvic inlet, especially in its antero-posterior diameter, but to contract the

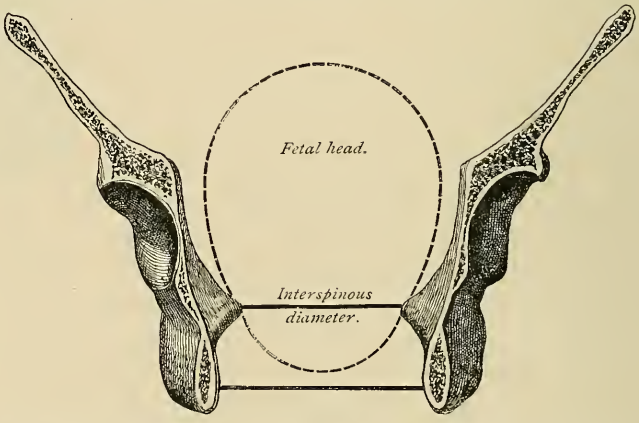

FIG. 41.—Vertical section of kyphotic pelvis, showing the head arrested by the spines of the ischia (Budin).

canal toward the outlet, where the diminution of the diameters is most marked, especially in the transverse (Pl. 34, Fig. 1).

In rare cases of lumbo-sacral kyphosis the upper portion of the sacral bone may be involved in the necrotic process, and the sacrum may exhibit deformities by destruction of its tissues (Pl. 34, Figs. 3, 4). The other characteristic deformities of the kyphotic pelvis are most marked in this type, unless, as in one instance, the body is bent almost double, and it is necessary

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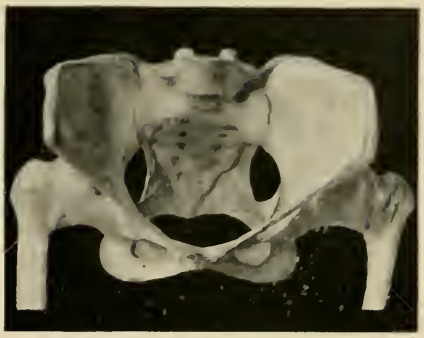

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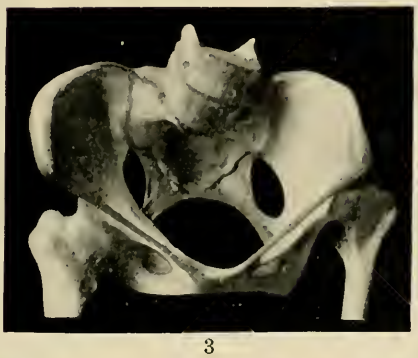

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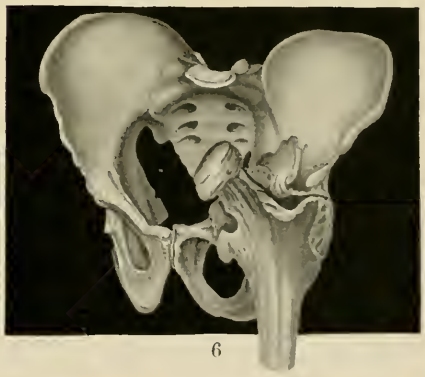

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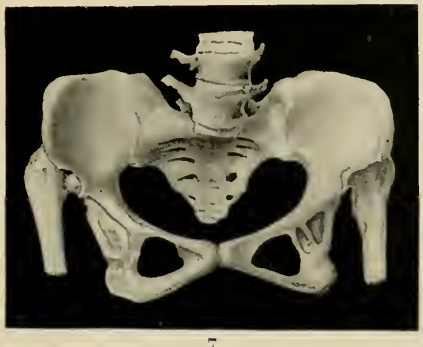

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1. Luxation of right femur. 2. Congenital luxation of both femora. 3. Luxation of left femur on dorsum of ilium, with false joint above acetabulum. 4. Congenital luxation of both femora (photograph of model). 5. Coxalgic pelvis (Mütter Museum, College of Physicians, Philadelphia). 6. Anterior dislocation of femur. 7. Congenital dislocation of the femora. 8. Pelvic deformity, the result of double club-foot (Meyer).

to rest the anterior portion upon an artificial support, as a cane. In this case the pelvis, although relieved of the weight of the trunk, is obstructed by the overhanging lumbar vertebræ to such a degree perhaps that the inlet is practically obliterated (pelvis obtecta). In all cases except the slightest of lumbosacral kyphosis the projecting lumbar spine blocks the pelvic inlet and seriously obstructs labor. In 21 labors complicated by this deformity of the pelvis 66 per cent. of the mothers and 75 per cent. of the children were lost (Winckel).

Influence on Labor.—The influence of the kyphotic pelvis upon labor is usually not felt until the presenting part has descended to the pelvic floor. In consequence of the shortened perpendicular diameter of the abdominal cavity there is a tendency always to transverse position of the fetus *in utero*, but this position is ordinarily corrected by the first few labor-pains.

Klein's[27] statistics, embracing 172 births in 95 women, give the head as presenting in 95 per cent. of cases, and the breech in 2 per cent.

When the head arrives at the pelvic floor, if the occiput is directed backward, anterior rotation will very likely be prevented and there will be a persistent posterior position. If the occiput is directed anteriorly, the transverse diameter of the head may be caught between the approximated tuberosities of the ischiac bones, and labor be brought to an indefinite standstill (Figs. 40, 41). A posterior rotation of an occiput originally directed anteriorly is not a rare occurrence. It occurred in 5 of Klein's cases and 1 of the writer's. Occasionally spontaneous delivery is possible on account of the extreme mobility of the pelvic joints in the kyphotic pelvis; in any case, as the progress of the head is retarded only when it reaches the pelvic outlet, the labor ordinarily is easily managed. The application of forceps may be sufficient to overcome the obstruction, but if it is not, a symphysiotomy will pretty surely do so unless the contraction is extreme or asymmetrical. Should the child be dead, craniotomy is readily performed with the head so accessible as it is on the pelvic floor. Face presentations are comparatively frequent —4 per cent. of the head presentations.

Diagnosis.—The diagnosis of a kyphotic pelvis presents no difficulties. The hump-back is obvious, and the history is easily obtained that the spinal deformity was developed early in life. The pelvic measurements diagnostic of this deformity show an increased separation of the iliac crests and the anterior spines, a diminished distance between the posterior superior spines, an approximation of the tuberosities of the ischiac bones, and some diminution in the antero-posterior diameter of the pelvic outlet. Care should always be exercised to detect asymmetry in these pelves, to discover an arrested development with general contraction, and to diagnosticate lateral contraction at the pelvic inlet. These complicating deformities constitute often insuperable obstacles in labor.

Management of Labor in Kyphotic Pelves.—An exact measurement of the pelvis is, of course, essential. If the child is of normal size, pregnancy may be allowed to go to term in pelves measuring 8.5 centimeters and over in the transverse diameter of the outlet. Any asymmetry of the ischia constitutes

a serious complication. With a measurement in the transverse diameter of the outlet of 8.5 centimeters to 6 centimeters, labor should be induced at the thirty-sixth week. A measurement of 6 centimeters or under absolutely indicates Cesarean section.

If the woman is first seen in labor at term, the head, if it is presenting, should be allowed to descend to the pelvic floor, and the woman should be encouraged to make vigorous expulsive efforts. If the occiput shows a tendency to rotate posteriorly, the movement should not be interfered with. With a measurement of 8.5 centimeters or over the woman will probably deliver herself spontaneously. Below 8.5 centimeters the forceps should be tried cautiously, but symphysiotomy will probably be necessary. In no other form of contracted pelvis is this operation so successful. The space gained is about 4.5 centimeters. This operation, therefore, might be expected to be successful in a transverse diameter of 6 centimeters or even a trifle less. If the child is dead, or if the more serious obstetrical operations are not permissible, craniotomy should be performed, in case the forceps fail. Version has given the worst results of all the obstetrical operations in kyphotic pelves and is, therefore, contraindicated as a rule. Klein's statistics show that in 60 per cent. of cases the labor must be terminated by operative interference.

Prognosis.—In the minor grades of contraction the maternal mortality is 6.6 per cent. In the graver cases, 16 per cent. The mortality of the infants varies in the different statistical tables from 36 to 49 per cent.

Frequency.—The kyphotic pelvis is said to be somewhat infrequent, but the practitioner in active practice will surely encounter several examples in the course of his career. The writer has had under his care 6 well-marked cases of kyphotic pelvis, in 2 of which Cesarean section was necessary. In the other 4 delivery was spontaneous. Klein found, in 42,113 labors, only 7 women with kyphosis—a proportion of 1 : 6016.

Scoliosis.—In the scoliotic pelvis there is some degree of oblique contraction. The innominate bone toward which the lumbar vertebræ are bent, receiving the greater part of the weight of the trunk, is pushed upward, inward, and backward by the extra pressure exerted upon it by the head of the femur. The acetabulum on this side is displaced anteriorly and upward; the symphysis is pushed over on the opposite side. The degree of asymmetry is rarely sufficient to constitute an obstruction in labor. The scoliotic pelvis is, however, most often rachitic, and in addition to the asymmetry of scoliosis there may be the contraction of a rachitic pelvis (Pl. 34, Figs. 6–8).

Kyphoscoliosis.—In a combination of kyphosis and scoliosis of the spinal column the pelvis will show, perhaps, the combined features of both, but the kyphosis, being of rachitic, not of carious, origin, is not angular, and is situated high in the dorsal region, where it may be compensated for entirely by lumbar lordosis (Fig. 334; Pl. 36, Fig. 1). The

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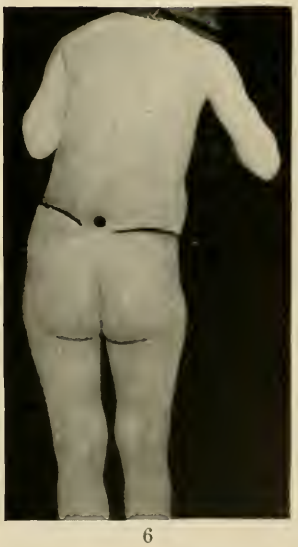

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1. Lumbo-dorsal kyphoscoliosis (Schauta). 2. Lordosis from paralysis of spinal muscles (Hirst). 3. Skeleton of a girl with coxalgia (Medical Museum, University of Pennsylvania). 4. Rear view. 5. Side view, of an obliquely-contracted pelvis, the result of tuberculous disease in one knee-joint (Hirst). 6. Scoliosis from unilateral atrophy of the spinal muscles (Hirst).

kyphoscoliotic pelvis is usually an asymmetrically contracted rachitic pelvis (Pl. 35, Fig. 1).

Lordosis.—Primary lordosis not the result of pelvic deformity or of spinal disease is very rare. Aside from some illustrations of it in an article by Neugebauer (*loc. cit.*), the writer knows of no reference to the subject except his own (Pl. 36, Fig. 2).[13] It may readily be seen what an influence this deformity would have upon coition and parturition, and how it might be an insuperable obstacle to natural completion of the latter.

FIG. 42.—Kyphoscoliosis (Leopold).

Anomalies due to Diseases of the Subjacent Skeleton: Coxalgia.—The deformity of the pelvis due to coxalgia in early childhood is of two types. In one there is an oblique contraction by a displacement of the innominate bone on the healthy side upward, backward, and inward, on account of the pressure of the femur, the weight of the body being received mainly upon the sound leg. This form of coxalgic pelvis, as a rule, presents no serious obstacle to delivery unless it is associated with a rachitic deformity (Pl. 35, Fig. 5; Pl. 36, Fig. 3). Special attention, however, should always be paid to the length of the conjugate diameter of the inlet and to the transverse diameter of the outlet. In the other variety of coxalgic pelvis the deformity is also an oblique contraction, but it is the bone on the diseased side which is driven inward upon the pelvic canal. This displacement of the innominate bone is the result of an arrested development on the corresponding side of the pelvis, and is very likely associated with an atrophy of the sacral ala and an ankylosis of the sacro-iliac joint. The contraction of the pelvic canal is much more serious in this form, and there may be all the difficulties in labor encountered in the true Naegele pelvis.

Luxation of the Femora.—Dislocation of the thigh-bones, if congenital

or occurring early in childhood and not corrected, has some effect upon the size and shape of the pelvis, but usually not enough seriously to obstruct labor. If one thigh is dislocated, the weight of the body may be thrown

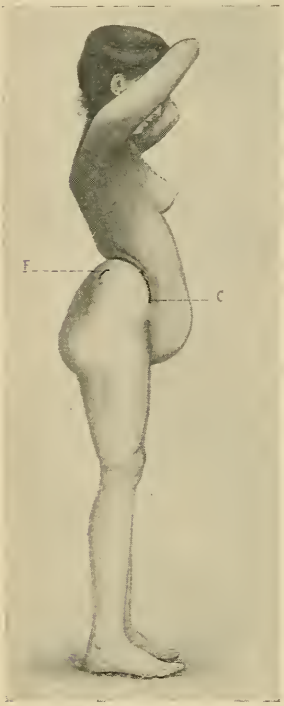

FIG. 43.—Congenital luxation of both femora: C, crest of ilium; F, trochanter of femur (Henry).

FIG. 44.—Case of congenital luxation of the femora.

mainly upon the other leg, and this may produce an oblique contraction of the pelvis of the kind already described (Pl. 34, Fig. 6). If the thigh-bone is displaced forward, the anterior half of the pelvis may be driven in a little upon the pelvic canal, and the head of the thigh-bone, as in one case reported, may project over the horizontal ramus of the pubis into the pelvic inlet (Pl. 35, Fig. 6). In the congenital luxation of both femora backward upon the iliac bones there is an excessive rotation forward of the sacrum, an increased width of the pelvic canal, and from the drag of the attached muscles and ligaments between the thighs and the pelvis the ischiac tuberosities are pulled outward, upward, and backward, so that the pelvic canal is made shallow and its outlet very wide. The heads of the femora move up and down on the ilia when the patient walks, and the distance between the lower edge of the symphysis and the inner condyles of the femora is shortened (Figs. 43–45; Pl. 35, Figs. 2–4, 7).

In the absence of one lower extremity the pelvis may be contracted obliquely to a serious degree, as in La Chapelle's case,* by the pressure on one side of the remaining leg. Any condition which throws the weight of the

* *Pratiques des Accouchements*, iii., p. 413; according to Schauta, the only one on record.

body mainly on one leg may produce the same effect, as is shown in a case of the writer's (Pl. 36, Figs. 4, 5), in which there was tuberculous disease of a knee-joint early in infancy, followed by marked shortening and atrophy of the leg. The weight of the body falling mainly on the sound leg, the corresponding innominate bone is pushed upward, backward, and inward, diminishing the area of intrapelvic space on its own side (Fig. 46). Torggler reports an interesting case of this kind in which the disability of one leg was due to scleroderma.[14] In the absence of both lower extremities there is the characteristic "sitz-pelvis," in which the innominate bones are usually rotated on an antero-posterior axis, so that the crests of the ilia are approximated and the tuberosities of the ischia are separated. Minor deformities of little practical importance may be the result of unilateral or bilateral club-foot or of the bowing of one or both lower extremities. In the former there is an increased inclination of the pelvis, an approximation of the acetabula and of the ischiac tuberosities, and a narrow pubic arch (Pl. 35, Fig. 8).

Fig. 45.—Ahlfeld's case of luxation of both femora.

Fig. 46.—Luxation and paralysis of the right lower limb (Winckel).

5. The Management of Labor Obstructed by the Commonest Forms of Contracted Pelvis: a Simple Flat, a Rachitic Flat, and a Generally-contracted Pelvis.

There is no situation in medicine where experience and good judgment count for more than in the management of labor obstructed by a contracted pelvis. It is extremely difficult to formulate hard-and-fast rules for the

guidance of the inexperienced where so many factors must be taken into account. The rules given below govern the writer's practice in the average case, but due attention must be paid to the history of past labors, the size of the child, its development and the compressibility of its head, the age of the woman, the build of both parents, and the probable strength of the expulsive forces, greatest in the primipara and less with successive labors.

If the diagnosis of a conjugate diameter of 9.5 centimeters or less is made during pregnancy, the physician must choose between induction of premature labor, or forceps, version, symphysiotomy, or Cesarean section at term. If the conjugate diameter measures as low as 9.5 centimeters, it is a safe plan to induce labor four weeks before the expected termination of pregnancy. This entails no additional risk upon the child if its parents are in a position to afford it the best care and nursing, and it is much the safest plan for the mother, the induction of labor, done properly, having no maternal mortality.* It is true that many women with a conjugate of 9.5 centimeters can deliver themselves without difficulty at term. Spontaneous delivery with a measurement as low as 8 centimeters and under has been recorded. But the majority of women with a conjugate of 9.5 centimeters will experience abnormal delay and difficulty in labor, with added risk to themselves and to their children; and in a certain proportion of cases a conjugate of 9.5 centimeters proves an insuperable obstruction in labor, and is the cause of ruptured uterus or death from exhaustion in the mother or of injury to the child's brain. These results are to be feared especially if the child is overgrown or if the mother's expulsive powers are weak—two conditions impossible to predict with absolute certainty. For these reasons, then, the rule to induce premature labor when the conjugate is at or below 9.5 centimeters is a safe one. If the conjugate measures 8 centimeters or under, the most successful treatment is the induction of premature labor at the thirty-sixth week, and then, if necessary, the performance of either symphysiotomy or Cesarean section when it appears that natural forces, aided, perhaps, by forceps, are not sufficient to secure the engagement of the head. By this plan the majority of women with a conjugate of 8 centimeters or a trifle less will be delivered spontaneously or with no more serious operation than the application of forceps. If the conjugate measures 7.5 centimeters or less, the induction of premature labor four weeks before term cannot be expected of itself to secure a spontaneous delivery. Symphysiotomy in suitable cases or Cesarean section will be required in the majority of instances. In such cases, therefore, the operator may wait until term before he operates. With a conjugate diameter of the superior strait below 6.5 centimeters the woman should be allowed to go to term and should be delivered by Cesarean section.

If the physician sees the patient for the first time in labor, or only

*This statement is based upon the writer's experience in private practice, and not upon hospital practice. It does not hold good for labors induced before the thirty-sixth week. In the discussion at the International Congress at Amsterdam in 1899 the maternal mortality was acknowledged to be 1 per cent. The mortality for the child averaged 37 per cent.

discovers the deformity after labor has begun, he must choose one of the following modes of delivery: A waiting policy to allow the engagement of the head by natural forces; the application of forceps; the performance of version; symphysiotomy; or Cesarean section. While the child is alive craniotomy should not be considered. The selection of the best mode of delivery in contracted pelves is one of the most difficult problems in obstetrics. If the patient is a primipara and the conjugate is above 9 centimeters, natural forces will in the majority of cases, provided the child be not overgrown, secure the engagement of the head,* although it may be by the expenditure of considerable force, after long delay, and only after prolonged moulding and an adaptation of the size of the head to the size of the contracted inlet by apparent anomalies in the position and flexion of the former. It is wonderful how successfully an obstruction may be overcome even in cases of contracted pelves with a conjugate of 8 centimeters or less. But while waiting for spontaneous delivery the physician may see the uterus suddenly rupture or may find the child's head after birth seriously injured. It is permissible in most cases to wait for the full, or almost full, dilatation of the os, keeping careful watch upon the woman's pulse, temperature, and general condition, upon the situation of the contraction-ring and the distention of the lower uterine segment, and taking whatever operative measures may be required in plenty of time to forestall the possibility of uterine rupture. The application of forceps to the head above the superior strait for the purpose of securing its engagement by forcible traction should in general be condemned, but it must be admitted that there are important exceptions to this rule. If one is skilled in the application of the forceps, bears in mind the transverse position of the head, and can gauge the degree of traction which may be exerted without injury to the child's skull or to the maternal soft structures, he will occasionally succeed in securing an engagement with the instrument that would otherwise, perhaps, be impossible. As a rule, however, it is safe to say that the choice lies between inaction and the performance of version. By the latter operation the smaller end of the wedge represented by the child's head is engaged in the contracted inlet, and there can be exerted upon the head coming last, both by traction on the body from below and by pressure on the head through the abdominal walls above, a degree of force that is impossible with forceps. It is well, however, to bear in mind the danger entailed upon fetal life when version is performed in a contracted pelvis. There is a considerable risk† that the head will be retained long enough above

*From 1881 to 1887 there was spontaneous delivery in one hundred and sixty three out of 444 cases of contracted pelvis in the Vienna Hospital, and in forty-seven women the conjugate was not above 8.5 centimeters (Braun u. Herzfeld, *Der Kaiserschnitt u. seine Stellung zur künstlichen Frühgeburt, Wendung, atypischen Zangenoperationen, Kraniotomie bei u. zu den spontanen Geburten*, Wien, 1888, ii. p. 144). In the Moscow Maternity there were 84 contracted pelves among 4000 births in 1894, 71 per cent. of these cases were spontaneously delivered (Küster, *Centralbl. f. Gyn.*, No. 10, 1895).

†The infantile death-rate will be at least 25 per cent., or more likely higher (Nagel, "Die Wendung bei engen Becken," *Arch. f. Gyn.*, Bd. xxxiv.).

the superior strait, or in it, to asphyxiate the child beyond revival.* Or the pressure upon the head by the pelvic walls may fracture the skull and crush the brain, and the force employed in extraction may break the neck. If in the judgment of the operator the danger entailed upon the fetus by version is too great, natural forces having failed to secure engagement, and if he has tried the forceps cautiously without success, his choice must rest between symphysiotomy and Cesarean section. The former must be the operation of election if the conjugate is above 7 centimeters; the latter, in cases of greater contraction. These rules for the treatment of labor obstructed by a contracted pelvis presuppose, of course, a fetal body and head of average size. This point must always be investigated carefully by abdominal palpation, although it is most difficult to determine. † If the physician has reason to believe that the child is over-size, he must allow himself sufficient latitude to ensure delivery. This advice applies particularly to cases in which the operator is in doubt whether to select symphysiotomy or Cesarean section. If, on the one hand, there is good reason to fear that the child cannot with safety to itself be extracted through the birth-canal after the former, his choice should rest upon Cesarean section. On the other hand, if the child is under-size (a condition easier to detect by palpation than is overgrowth), spontaneous delivery may be expected through a pelvis that would not permit the passage of a child of normal size. Klein and Walcher declare that by raising the buttocks and letting the legs hang down as far as possible, the conjugate is lengthened by almost a centimeter. Clinical tests of the method have been described as attended with success. The writer has found the Walcher posture to be of decided advantage, and would recommend its systematic trial.‡

6. Obstruction to Labor on the Part of the Soft Maternal Structures in the Parturient Canal.

Congenital Anomalies of Development in the Uterus.—A double or septate uterus may complicate labor in several ways. The bulk of the unimpregnated half may obstruct delivery, especially if this half is retroverted and is increased considerably in size in sympathy with the development of the impregnated side and is hardened in consistency by sympathetic contraction during the labor-pains. The septum itself may prove an obstacle in labor, and sometimes labor is obstructed by the strong vesico-rectal ligament that

* Nagel reports 60 cases of version for contracted pelvis, with a fetal mortality of 25 per cent. (*ibid.*, p. 168.).

† The relative size of head and pelvis may be determined approximately by the method of Müller and Schatz: The fetal head is grasped between the extended fingers of the physician, and is pressed down steadily and for some time upon the pelvic brim (see p. 88), the direction of the force coinciding with the axis of the superior strait. If this maneuvre succeeds in pressing the head within the pelvis, then natural forces will surely secure engagement. If it fails, the converse by no means necessarily follows.

‡ *Zeitschr. f. Geburts. u. Gyn.*, Bd. xxi., H. 1; and *Med. Korresp. Bl. des Würtemb. Aerztl. V.*, Bd. lx. 5. Lebedeff and Bartosziurcz, by experiments on 25 cadavers, found that the Walcher posture increased the conjugate 1–3 mm. (*Int. Congress for Gyn. and Obst.*, Amsterdam, 1899); Pinzani, in 62 observations, found an increase of 1–8 mm. (*ibid.*).

runs between the horns of a bicornate uterus. If the placenta is attached to the septum, alarming hemorrhage may occur from imperfect contraction of the sparsely-supplied muscular fibres in it: malpresentations and a faulty direction and insufficient power of the expulsive force are common. Rupture of the

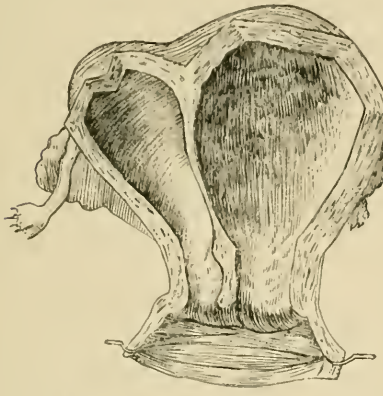

Fig. 47.—Uterus septus (Cruveilhier).

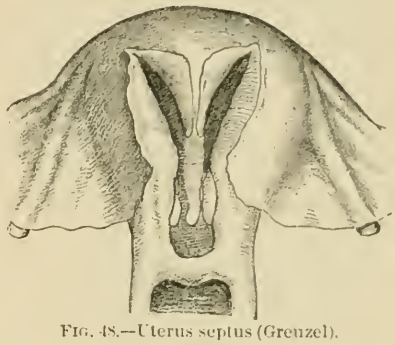

Fig. 48.—Uterus septus (Grenzel).

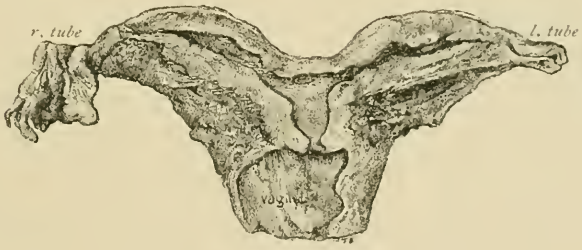

Fig. 49.—Uterus bicornis (Winckel).

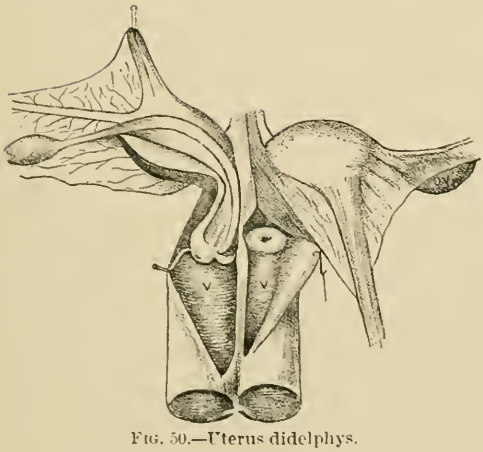

Fig. 50.—Uterus didelphys.

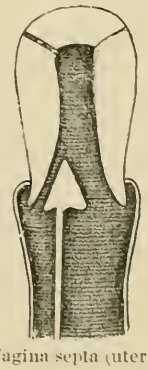

Fig. 51.—Vagina septa (uterus biforis).

uterus is to be feared on account of the ill-developed uterine walls. Laceration of the septum frequently occurs. It has been noted that a decidual membrane may be retained within the non-pregnant half of the uterus, where, undergoing putrefaction after delivery, it may give rise to septic infection. There seems

also to be a disposition to the retention of membranes in the pregnant side of the womb. Retention of the placenta is not uncommon, partly because of insufficient expulsive force, partly on account of its situation, perhaps attached in both divisions of the uterine cavity. Thévard[15] reports the retention of the placenta in a double uterus for fifty days, when it was spontaneously discharged. It has happened in cases of double uterus and vagina that the physician examined the wrong side, and was ignorant of the progress of labor until the child was about to be born; also that he examined first one side and then the other, finding first a dilated and then a contracted external os.

In one woman with a double uterus there was noted a disposition to become pregnant in regular alternation first on one side and then upon the other.[16]

Closure and Contraction of the Cervix.—The cervix may obstruct labor by reason of atresia, cicatricial infiltration, contraction, and rigidity, or there may be longitudinal or transverse septa in the canal. Atresia of the cervix in a pregnant woman must, of course, be acquired after impregnation (conglutinatio orificii uteri externi); it is rarely, however, complete. There is always an indication at least of the external os in a dimple evident to the sense of sight, if not to that of touch. By pressing upon this point with a fingernail or with the tip of a uterine sound a small artificial opening may be made. Directly this is secured the dilatation of the external os proceeds in a remarkably rapid manner, although hours of vigorous labor-pains before had been insufficient to begin it. If this plan fails, a crucial incision must be made in the cervical tissues at the site of the external os. The dilatation of the small opening thus made is then left to nature. If hemorrhage follows the incisions, the bleeding points should be secured by sutures. An active treatment is always called for. Without it the uterus may rupture, the vaginal portion of the cervix may be torn off from the womb, or the head[17] may emerge completely covered by the enormously distended cervix as by a caul. *Cicatricial contraction* or *infiltration* of the cervix is the result of old unrepaired tears, of operations upon the cervix, of cauterization, of syphilis, or of cancer. In the first instance the resistance to dilatation is scarcely ever great, and what there is may be overcome almost always by hydrostatic dilators, by the application of forceps and forcible delivery of the head through the cervical canal, or by the performance of version followed by rapid extraction. If the cicatrices are of syphilitic or of cancerous origin, the obstruction is more serious. It may be overcome by radiating incisions with scissors or with a probe-pointed bistoury, but it is not unlikely to demand the performance of Cesarean section.

Rigidity of the cervix is seen normally in all primiparæ, and to an exaggerated degree in elderly primiparæ. It yields often to copious douches of warm water directed against the anterior wall of the cervix and frequently repeated—as often as once every fifteen minutes if necessary. Chloral internally and belladonna ointment applied directly to the cervix have been recommended, but these remedies are not to be depended upon except in the slight rigidity characteristic of all primiparæ. If there is delay in such cases, 15 grains of chloral every fifteen minutes for three doses may advantageously be

given. An anesthetic, after all, is the most valuable medicinal agent that we possess for the relaxation of this as well as of other rigid tissues. The rigid cervix yields at length to the steady pressure of the presenting part, and it is rarely necessary on account of rigidity alone to resort to artificial dilatation or to incisions. In the course of a slow dilatation of the cervical canal and external os the anterior lip of the cervix may become incarcerated between the head and the pelvic walls. In consequence of the pressure and the disturbance of circulation in the part the cervical tissues rapidly become edematous, and the bulk of the anterior lip becomes so great as actually to constitute a mechanical obstruction to the descent of the head. It is usually possible in such cases to push up the anterior lip over the head and above the symphysis in the intervals between the pains. If there is hypertrophy of the anterior lip in consequence of an old laceration and eversion, or, all the more, should there be hypertrophy of the whole infravaginal portion of the cervix, the obstruction may become quite serious, and it may be impossible to push the cervix above the head. In such cases forcible traction on the forceps or radiating incisions in the cervix may be necessary.

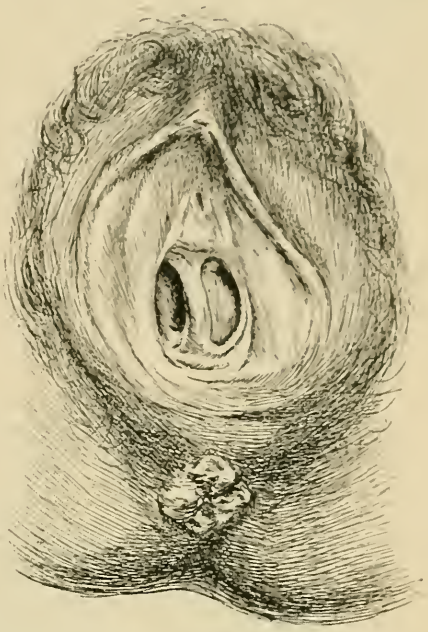

FIG. 52.—Double vagina.

Longitudinal septa in the cervical canal are usually seen with duplicity of the uterine cavity from failure of the Müllerian ducts to fuse completely. Occasionally the lack of fusion is confined to the cervical canal alone (uterus biforis). Rarely transverse septa have been found in the cervical canal.* It may be necessary to cut these before the child can pass into the vagina.

Closure and Contraction of the Vagina or Vulva.—There may be obstruction of the lower birth-canal by longitudinal and transverse septa, by cicatrices, by hematomata, by partial atresia, especially at the upper third of the vagina, by unruptured hymen, by anus vaginalis, by vaginal tumors and cysts, by cystic and solid tumors of the vulva, by enlarged carunculæ myrtiformes, by varices, by vaginismus, by congenital narrowness of the vagina and vulva, and by rigidity of the tissues, especially in elderly primiparæ.

Longitudinal and Transverse Septa.—These are not ordinarily very dense in structure, and they give way commonly before the advance of the presenting part. If they do not yield, it is easy to cut them in one or more places, the

*Cases are reported by Müller, Breisky, Budin, Henry, Bidder, and Blanc (Pozzi's *Gynæcology*, vol. ii. p. 456).

hemorrhage being controlled, if necessary, by sutures afterward, or in the case of transverse septa by a double ligature applied first, the septum being cut between, though there is not much tendency to bleeding even in those as thick as one's finger (Fig. 53).

Hematomata.—Hematomata of the parturient tract usually occur at the vaginal orifice, and most often between the birth of twins. They are considered here only as mechanical obstacles to labor (see p. 195). If the blood-tumor is large enough to constitute an obstruction to the escape of the child, its walls must be incised and its contents be turned out, and

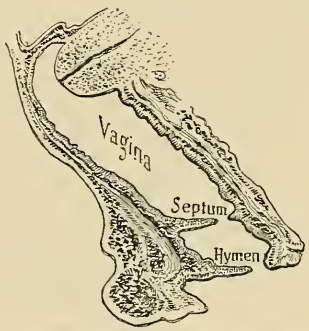

FIG. 53.—Transverse septum of the vagina (Heyder).

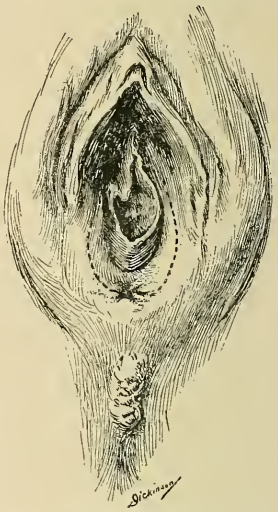

FIG. 54.—Anus vestibularis: dotted lines show the limit of mucous membrane; thickened skin marks the normal site of the anus (Dickinson).

if hemorrhage follow it must be checked by a firm tampon, preferably of iodoform gauze, in the cavity of the tumor.

Extensive cicatrices in the vagina from syphilitic, malignant, or other ulceration, or from former injuries, may be stretched sufficiently by hydrostatic dilators or may be severed by multiple incisions, followed by the application of forceps if the head is presenting; but they may be too dense and extensive to yield to these measures, and a Cesarean section may be required.

Unruptured Hymen.—An unruptured hymen is not necessarily a bar to conception. There are a number of cases on record in which a persistent hymen with a small orifice has obstructed to some degree the escape of the child's head in labor. In two cases under the writer's notice the advance of the presenting part ruptured the hymeneal membrane without difficulty, but it has been found necessary by others to incise it.[18]

Atresia of the Vagina.—This anomaly of development has its seat usually at the upper third of the canal, where the vagina may be contracted to a narrow tract barely admitting the uterine probe, or the canal may be obstructed by an annular membrane like the hymen. Although Cesarean section has been done for this condition, the majority of cases on record have not required it. The advance of the presenting part has dilated the narrowed vaginal canal with little more difficulty than it experiences in dilating the cervical canal. At the worst the obstruction should be overcome by digital, instrumental, or

hydrostatic dilatation. In complete or almost complete acquired atresia of the lower portion of the vagina, in which insemination has taken place by way of a dilated urethra and a vesico-vaginal fistula, the imperforate portion of the vagina may be opened by a transverse incision, the rectum and bladder being guarded by a finger in the one and a sound in the other.

Anus Vaginalis or Vestibularis.—This condition may complicate labor by the accumulation of feces in the rectum, due to the unnatural position of the anus (Fig. 54). In one case in which this anomaly was associated with partial atresia of the vulvar orifice it was necessary to cut the perineal structures upward from the rectum toward the pubis in order to permit the escape of the child's head.

Cystic and Solid Tumors of the Vagina and Vulva, Edema, Suppuration, and Gangrene.—In the case of solid tumors excision may be necessary, by transfixing the pedicle if they have one, and ligating it to prevent hemorrhage,

FIG. 55.—Edema and beginning gangrene of the vulva from prolonged pressure in an obstructed labor (Hirst).

or by an incision of the vaginal wall over them and their enucleation, followed by the immediate extraction of the child, and the control of hemorrhage by the needle and thread or by direct pressure. In the case of large cystic tumors a puncture is sufficient to remove the obstruction. Güder[19] collected 60 cases of vaginal tumors complicating labor—23 cysts and echinococcus sacs, 18 fibroids, fibromyomata, and polyps, 14 carcinomata, 1 sarcoma, and 4 hematomata. Delivery was accomplished by the following diverse methods: spontaneously, 14; by forceps, 18; by version and extraction, 2; by traction on the feet, 1; by removal or puncture of the tumor, 16; by Cesarean section, 7; by induction of premature labor and craniotomy, 2; by premature labor, 3; by laparo-elytrotomy, 1; by craniotomy, 1; by pushing back the tumor and extracting the child past it, 2. Among the mothers there were 15 deaths; among the children, 13. In 11 of the mothers and in 22 of the children the result was not reported.

Edema of the vulva may be the result of kidney insufficiency or of pressure

in a prolonged labor. The increased bulk of the dropsical labia may interfere with the escape of the presenting part, or, what is more likely, the edematous tissues lose their elasticity, obstruct labor by their rigidity, and are prone to deep tears at the time of birth and to gangrene afterward. Punctures or incisions in the labia may be necessary to escape more serious injury, but it is well to avoid them if possible, for they are apt to be followed by infection and gangrene.

An abscess of Bartholin's gland is seldom large enough to retard labor, though it has done so (Müller), but it is likely to cause trouble afterward. It should be opened freely in the early part of the first stage of labor, curetted, swabbed out with carbolic acid and glycerin, and packed with iodoform gauze.

Gangrene of the vulva is very rare before the termination of labor. Should it exist, it might determine an operator in favor of Cesarean section in a doubtful case, on account of the rigidity of the vulvar tissues, the certainty of laceration, and the likelihood of grave infection.

Enlarged Carunculæ Myrtiformes and Varicose Veins.—These tumors do not possess sufficient bulk, as a rule, seriously to obstruct the last stage of labor. They may, however, be so bruised by the passage of the head as to slough afterward, or the veins in them may be ruptured, giving rise to subcutaneous or frank bleeding of an alarming character.

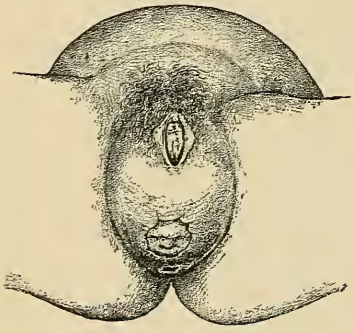

FIG. 56.—Central tear in the perineum, with contracted vulvar orifice (Ribemont-Dessaignes).

Vaginismus may be overcome by an anesthetic. *Congenital narrowness* of the vagina and vulva is usually overcome by the advance of the presenting part, though often at the expense of vaginal and perineal lacerations. It may be necessary to resort to hydrostatic dilatation, or even, in rare instances, to Dührssen's plan of multiple incisions. In the case of extreme narrowness of the vulva there may be a central tear of the perineum, through which the presenting part begins to emerge. To avoid a rectal tear in such a case the perineum should be cut from the anterior border of the perforation to the posterior commissure of the vulva (Fig. 56).

Rigidity of the tissues in the cervix, the vaginal wall, and at the outlet occasions delay in the majority of all primiparæ, but especially in the case of elderly primiparæ—those over thirty years of age. Eckhard found the infantile mortality in such cases to be 19.81 per cent., the maternal mortality to be three times as great as in younger primiparæ; and the necessity for operative interference increases steadily with the age of the primiparæ until, in those past forty, almost two-thirds are delivered by some operative procedure, usually forceps. Craniotomy should be done if the child is dead. Version is the least successful operation in these cases.

Displacements of the Uterus.—The uterus in labor may be displaced forward; to either side; downward; or backward, by the so-called "saccula-

tion" of the womb. It may be twisted on its pedicle, the cervix, or it may form part of the contents of a hernial sac in inguinal or ventral hernia.

Anterior Displacement of the Uterus in Labor; Pendulous Belly.—This is a

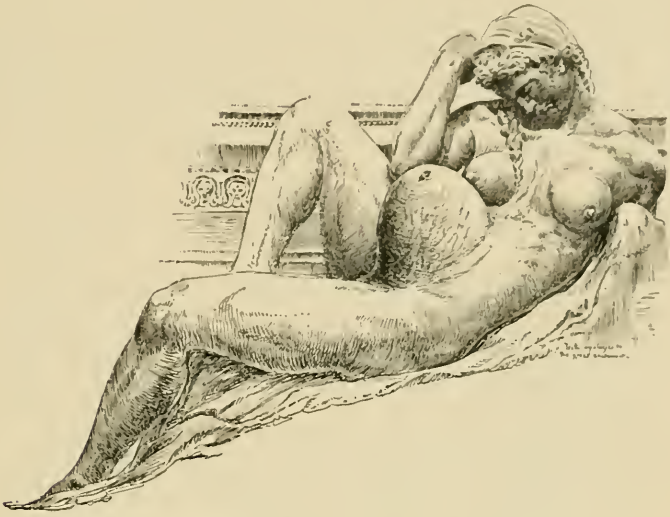

FIG. 57.—Hernia of the gravid womb through the linea alba.

common anomaly in labor, seen to some degree in all cases of obstructed labor, as in deformed pelvis, and in all cases in which the length of the abdominal cavity is decreased, as in kyphosis. A peculiar example of forward displacement is seen in those rare instances of hernia of the parturient womb between the recti muscles or to one side of the median line during the second stage of labor (Fig. 57). The pregnant womb may fall forward also into an umbilical hernia or into a ventral hernia following celiotomy.

FIG. 58.—Inguinal hernia containing a gravid womb (Winckel).

The removal of the obstruction to labor in the first class of cases will ordinarily obviate the anterior displacement. If the displacement depends not upon obstruction, but upon flaccid abdominal walls, the application of an abdominal binder surely corrects the anteversion. In cases of hernia of the uterus through the anterior abdominal wall artificial delivery with forceps or by version may be necessary; when the uterus is evacuated it can easily be returned into the abdominal cavity. A tight abdominal binder and the diminution of intra-abdominal pressure after delivery will promote the approximation of the separated recti muscles. In inguinal hernia the pregnant womb in the hernial sac is usually unicorn or bicorn (Fig. 58). Delivery may

be effected by version, and this may be followed by a reduction of the hernia, but it is best to lay open the sac, incise the womb, extract its contents, and then amputate it.*

Labor Complicated by a Former Operation to Suspend or Fix the Womb Anteriorly.—The number of operations performed for posterior displacement of the uterus on women of child-bearing age has of recent years become so large that ample opportunity has been afforded to judge of their influence on pregnancy and childbirth. Dorland[28] has collected the statistics of 179 pregnancies following operations for ventro-suspension, ventro-fixation, and vaginal fixation. It appears from these statistics that the firmer the womb is fixed and the lower the fundus is fastened, the more certainly will there be serious disturbance in pregnancy and dangerous complications in labor. Abortion occurred in 14 per cent. of the ventro-fixations and 27 per cent. of the vaginal fixations. In 12.29 per cent. of the cases there was dystocia, requiring, in three instances, Cesarean section. The complications noted in labor were: inertia uteri, transverse presentations, anomalies in placenta and position of child's head, postpartum and puerperal hemorrhages, and mechanical obstruction from the thick anterior wall of the uterus being held down over the inlet, the distention of the uterus in pregnancy having been accomplished by the distention of the posterior uterine wall. Pregnancy was seriously disturbed in 8.37 per cent. of the cases, not counting those in which abortion occurred, by pain and traction at the site of the incision, dysuria, and excessive nausea and vomiting.

A sure indication of the difficulty to be experienced in labor is afforded by the behavior of the fundus and cervix of the womb in pregnancy. If the former remains fixed over the symphysis while the latter is steadily drawn upward and backward until it reaches the promontory of the sacrum or actually ascends above it, labor will be seriously complicated. In such a case, in the hands of an expert abdominal surgeon, the best treatment consists in dividing the adhesions between the fundus and the anterior abdominal wall.

The best preventive treatment of this complication consists in the selection of the appropriate operation and its proper performance. Vaginal fixation should not be selected. If the operator uses fine silk and includes only a part of the rectus muscle with the peritoneum in the abdominal portion of the stitch, the resulting adhesion is so flexible that it can hardly cause any serious trouble. In not one of the numerous women operated on by the writer has there been the slightest complication.

Lateral Displacement.—A tilting of the uterus to the right side is a physiological occurrence in pregnant and parturient women. The lateral inclination is sometimes exaggerated to such a degree that a great part of the expulsive force is lost by the propulsion of the presenting part against the lateral wall

* Adams[20] has collected 10 cases of inguinal hernia of the gravid womb, including Doringius', which he calls "crural." In eight Cesarean section was done. In one the delivery was spontaneous.

of the pelvis. The displacement can be corrected by turning the woman on her side—usually the right—toward which the fundus uteri is inclined, and placing under her flank a rolled blanket or a pillow.

Saeculation of the Uterus.—A backward displacement of the gravid womb in rare cases goes on to full development by what is called "posterior saeculation," the distention of the uterus to accommodate the full-grown fetus being accomplished by stretching the anterior uterine wall, the posterior wall and the fundus remaining fixed within the pelvis (Fig. 59). In these cases the cervix is high above the pelvic inlet and is pressed close against the anterior abdom-

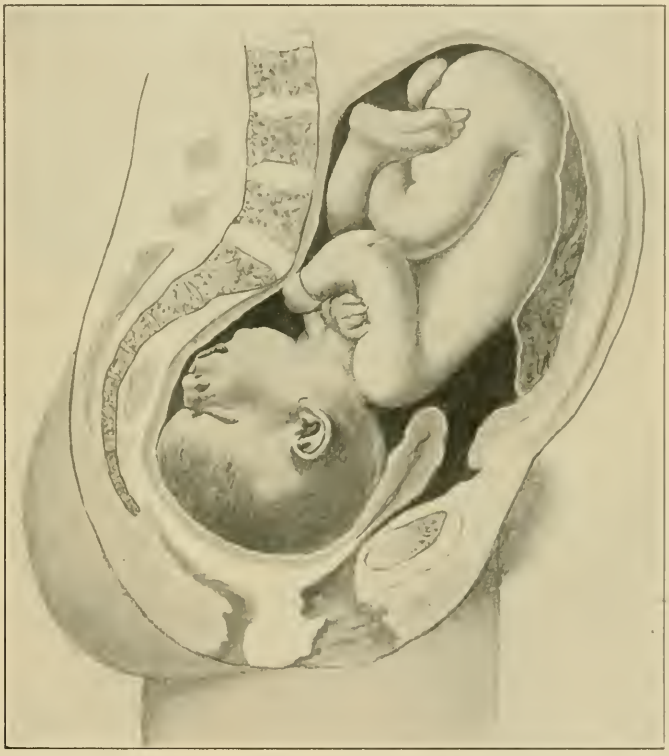

FIG. 59.—Saeculation of the uterus.

inal wall, the posterior vaginal wall bulges outward and downward, and fetal parts can be felt through it with a distinctness that suggests abdominal pregnancy. Cesarean section has in one instance at least been performed on account of this anomaly, but a study of recorded cases shows it to be unnecessary. By the artificial dilatation of the cervical canal and the performance of podalic version delivery can be effected without difficulty.

Partial Prolapse with Hypertrophic Elongation of the Cervix.—It is impossible for pregnancy to proceed to term with complete prolapse of the womb, although the size of the uterine tumor projecting from the vulva in some cases has given rise to a belief in this possibility (Fig. 61). A careful

examination has always shown the major portion of the uterine body to be within the pelvic and abdominal cavities. Commonly the fundus is at a

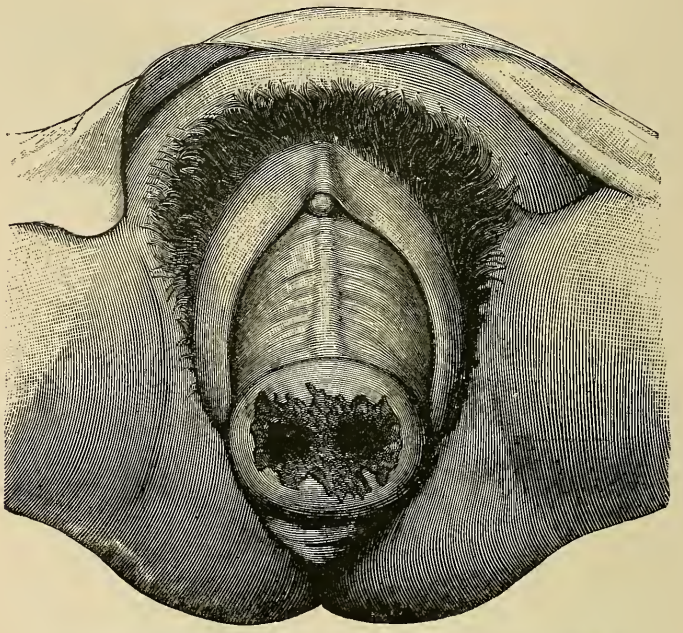

FIG. 60.—Prolapse of a double uterus in a pregnant woman (Maygrier).

normal level, and the descent of the cervix has been accomplished by stretching the lower uterine segment and by hypertrophic elongation of the cervix itself. When the contraction of the uterine muscle begins in labor, a partial prolapse of the womb is usually

FIG. 61.—Partial prolapse of the womb in labor (Wagner).

FIG. 62.—Partial prolapse of the womb and hypertrophy of the cervix (Faivre).

spontaneously corrected by the retraction of the cervix within the vagina. This the writer has seen in several instances. In exceptional cases, however—usually

on account of a rigid cervix—the prolapse becomes aggravated or suddenly makes its appearance, and the cervical tissues, growing edematous and becom-

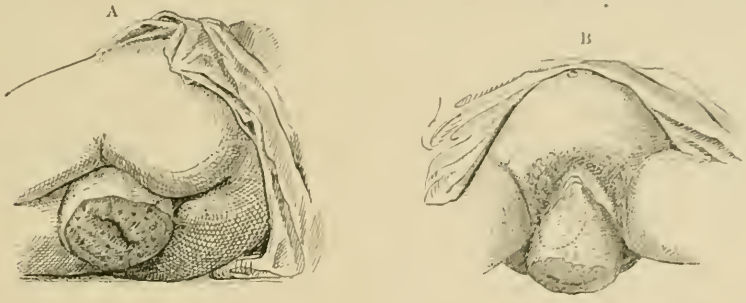

FIG. 63.—Partial prolapse of the womb and hypertrophy of the cervix: A, lateral position; B, dorsal position (Faivre).

ing enormously swollen, constitute by their bulk and increased rigidity a serious obstruction to the delivery of the child. This difficulty was overcome in an ingenious manner in a case reported by Faivre.[21] The woman was placed

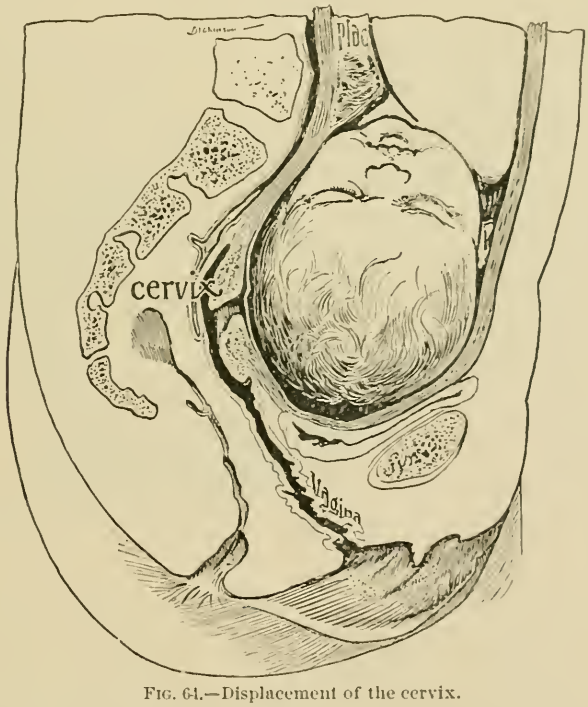

FIG. 64.—Displacement of the cervix.

in the dorsal position across the bed, a forceps was applied to the child's head, and an assistant, standing astride the woman's body, hooked his fingers into the cervix and pulled upward to counteract the traction of the forceps upon the child's head and the incarcerated cervical tissues. It might be necessary in such a case to enlarge the cervical canal by radiating incisions. The hemorrhage following might be controlled temporarily by clamping sutures over the wounded surfaces without uniting them (Figs. 62, 63).

Displacement of the Cervix.—It is not uncommon in primiparæ with a narrow cervical canal for the cervix to be displaced backward, so that the external os, almost inaccessible to the examining finger, points directly backward or even backward and upward. The anterior lower uterine segment is much distended by the presenting part and occupies the whole vaginal vault. The expulsive force in labor is exerted against the lower uterine segment, and the cervical canal remains undilated. The difficulty can be overcome by applying an abdominal binder and by hooking the cervix forward with the finger during two or three pains (Fig. 64).

Tumors of the Genital Canal.—*Carcinoma of the Cervix.*—In 34 per cent. of cases cancer of the cervix will interrupt gestation at various

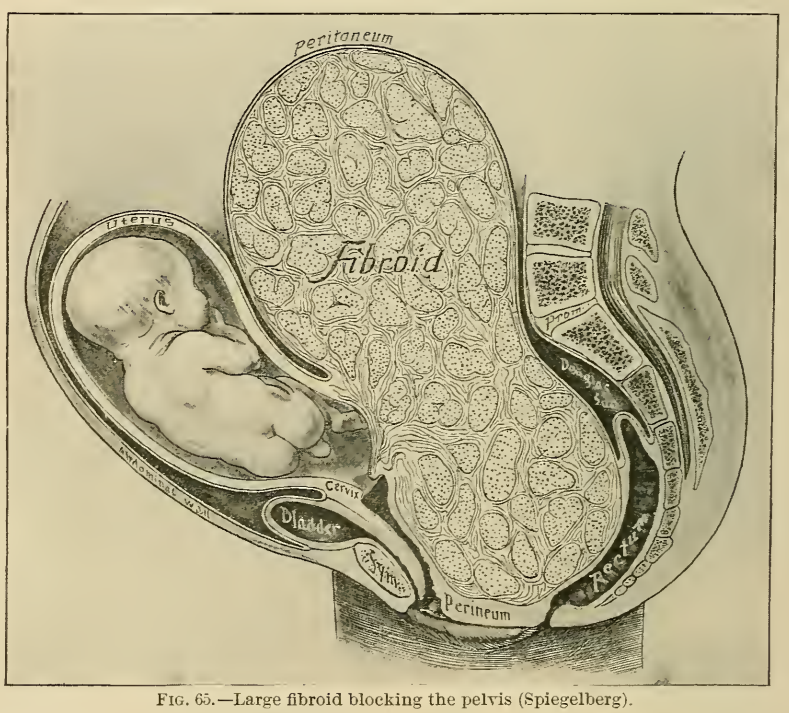

FIG. 65.—Large fibroid blocking the pelvis (Spiegelberg).

stages, but in a certain percentage (66, according to Müller) the pregnancy goes to term. If the disease is not too far advanced, if it is confined to one lip of the cervix, and that the anterior, and if there is not too much cicatricial infiltration around its periphery and up the cervical walls, the labor may be terminated spontaneously, but this is rather the exception. The performance of Cesarean section is commonly the proper treatment for labor obstructed by carcinoma of the cervix, and this operation should be selected if there is good reason to doubt the possibility of spontaneous or artificially-assisted delivery by the natural passage-way. The woman's life is surely doomed in the near future, and the child at any rate should be saved, even at considerable risk to the mother. It may be desirable to operate before the fetus has reached

maturity if the disease is making such rapid progress that the maternal life is not likely to endure until the natural end of pregnancy, or if the cancer is still in the operative stage. On abdominal or vaginal pain, hysterectomy should follow the Cesarean section, if possible.

Fibromata.—Fibroids of the uterus and cervix low enough in situation to become incarcerated in the pelvis are likely to constitute insuperable obstructions in labor, besides complicating parturition by favoring abnormal positions of the child, by predisposing to adherence of the placenta, to prolapse of the extremities and cord, and to hemorrhage during and after labor. If the tumor grows on the anterior wall of the uterus, the first few labor-pains and the contraction of the longitudinal fibres of the cervix may dislodge it above the pelvic brim, though it had been impossible to do this before by manipulation. The writer has seen one such case. It is also possible for tumors on the anterior wall of the cervix to be pushed out of the vulva in front of the presenting part, thus making room for the escape of the latter. If, however, the tumor is situated laterally or posteriorly, its artificial displacement upward into the abdominal cavity, so that the child may escape past it, is often impracticable (Fig. 65). On the contrary, the attempt at descent of the presenting part in labor must fix it more firmly in the pelvic cavity.* In this case, if attempts under anesthesia to dislodge the tumor and to push it above the pelvic brim fail, a Porro-Cesarean operation should be performed, even though the tumor is not of such great size as absolutely to prevent the delivery of the child. The physician must consider the effect upon it, owing to its low vitality, of the pressure to which it will be subjected by dragging the child past it (Fig. 66). Sloughing, gangrene, and fatal infection are likely to follow. This was the history of the case illustrated in Figure 66, communicated to the writer by Dr. J. P. Simpson of South Carolina. If the fibroid is submucous and grows from the cervix, it may be enucleated when labor begins. The bed of the tumor should be packed with gauze after labor.†

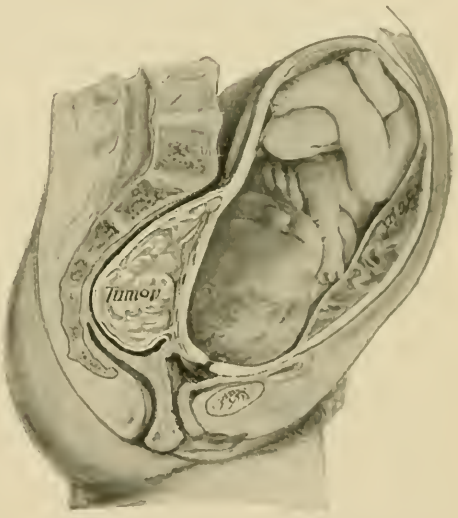

FIG. 66.—Small fibroid past which the child was extracted. The tumor became gangrenous and the woman died (Simpson).

* It is barely possible that a tumor low down on the posterior wall of the cervix, the most unfavorable of all positions, may be suddenly elevated after many hours of labor, and thus allow a spontaneous delivery; but this event is not to be counted on in practice.

† Sutugin is an enthusiastic advocate of vaginal operations for all cases of fibroids impacted in the small pelvis. For intramural tumors the cervix is split until the tumor is reached. For subserous tumors the vaginal vault is opened. Nine such operations *sub partu* are reported, with only one death (*Jahresb. ü. d. Fortsch. a. d. Gebiete der Geburtsh., etc.*, vol. v. p. 175).

It is, unfortunately, a common error to overlook a fibroid tumor obstructing the pelvis in labor or to mistake it for the fetal head. The woman is allowed to die of ruptured uterus, exhaustion, or hemorrhage while the physician is waiting for the descent of the presenting part or is endeavoring to apply the forceps to what he takes to be the head. Ordinary care and some little experience in making obstetrical examinations should guard a practitioner against such an egregious mistake.

The prognosis of labor complicated by a fibroid tumor depends upon the early recognition of the growth and upon the treatment. In general practice the results have hitherto been bad. Nauss found a maternal mortality of 54 per cent. among 225 women, and an infantile mortality of 57 per cent. in 117 cases. Süsserott found in 147 cases a maternal mortality of 50 per cent. and an infantile mortality of 66 per cent.[22]

A fibroid tumor may prolapse into the pelvis after the birth of the child and prevent the delivery of the placenta.

In Lefour's statistics of 300 cases of fibroids complicating labor the mortality of delivery by the natural passage was 25 to 55 per cent. for the mothers, 77 per cent. for the children.[23]

A fibroid tumor may practically disappear during the involution of the uterus. In ten cases under the writer's observation a spontaneous cure occurred twice in this manner. In four of the cases celiotomy was required during the puerperium—myomectomy twice and hysterectomy twice.

Polypi.—Polypoid tumors obstructing labor usually spring from the cervical canal or the anterior lip, and are mucous in character. They may, however, be fibromyomatous, fibrous, or sarcomatous, and may have a situation high in the uterine cavity or in its wall. They may increase very markedly in size during pregnancy. Their pedicle is usually small, and in the case of cervical polyps their removal is easy. The operation should be postponed, however, until the woman falls into labor, for any operative interference in this region would very likely interrupt gestation. When the dilatation of the os begins the pedicle can be transfixed and ligated and the tumor be cut away. Even if these growths are not sufficient in bulk to obstruct parturition mechanically, they have been known to give rise to profuse hemorrhage in the first few days of the puerperium, and their removal is desirable, therefore, even though they be small in size. In the case of fibromyomatous polyps of the uterine body, the tumor has on rare occasions been torn from its pedicle during labor and expelled in front of the child.

Tumors of Neighboring Organs.—*Ovarian Cysts.*—An ovarian cyst is a rare complication in labor. In 17,832 births in the Berlin Frauenklinik an ovarian cyst was found only five times. The number of abortions in pregnancies complicated by ovarian cysts is somewhat larger than common, but still a large proportion of these cases proceed to term. Of 321 pregnancies complicated by the presence of ovarian cysts, there was premature interruption in fifty-five (Remy). If the cyst is discovered during pregnancy, its removal should be attempted. Ovariotomy during gestation is not necessarily a dif-

ficult or dangerous operation, nor does it, as a rule, interrupt pregnancy.* If the tumor is first discovered after the woman has fallen into labor, and if it has become displaced downward into the pelvic cavity and is incarcerated, resisting all efforts to displace it upward even under anesthesia, its puncture through the vaginal vault, after a thorough cleansing of the vaginal mucous membrane and with a thoroughly aseptic technique, is possible, if one could be sure that it is unilocular and not a dermoid; but it is impossible to know this beforehand. It is a matter for serious consideration, however, whether Cesarean section followed by the removal of the tumor is not better. It is the writer's conviction that it is. By this plan many dangers in the puerperium are escaped. Twisted pedicle, intracystic bleeding and shock, occlusion of the bowels, rupture of the cyst, suppuration of the cyst-contents and consequent peritonitis, are all surely avoided. A number of cases treated thus should give a better mortality record than has hitherto been secured. In Heiberg's statistics of 271 cases there was a maternal mortality in pregnancy of more than 25 per cent. and a fetal mortality of more than 66 per cent. In deliveries by forceps without puncture of the cyst the maternal death-rate has been 50 per cent.; with puncture almost as great; and after version without puncture more than 50 per cent. Flaischlen recommends the vaginal puncture, or if necessary a vaginal incision and thorough evacuation of the tumor, then the delivery of the child, and on the following day at the latest an abdominal section for the removal of the tumor. This procedure does not seem to the writer so good a plan as the coincident Cesarean section and ovariectomy. Should the physician prefer vaginal puncture—which requires, of course, no special surgical skill—he should remember that if the tumor be densely adherent, possess thick walls, and possibly be a dermoid cyst, puncture through the vaginal vault is likely to be followed by gangrene of the tumor-contents and walls and by general infection. This will necessitate a hurried abdominal section in the puerperium, with the patient in a bad condition to endure it. Moreover, if the cyst is multilocular, it may be impossible to reduce its size sufficiently by vaginal puncture to permit the delivery of a living infant. The writer has experienced both the disadvantages of this plan of treatment.

Spontaneous delivery in spite of an ovarian cyst incarcerated in the pelvis has been noted after the cyst ruptured, after it had been spontaneously dislodged upward above the brim, or had perforated the vaginal vault or the rectum. As an ovarian cyst must be impacted in the pelvis to obstruct the delivery of the child, it is easily understood that there is more difficulty and danger in labor from a small than from a large tumor (Fig. 67). After the child is born a cyst that had before been above the brim may descend into the pelvis and obstruct the delivery of the placenta.

Vaginal Enterocele.—Vaginal hernia is a very rare obstruction in labor. The writer has been able to collect but 27 cases from medical literature. Of

* Dsirne has collected statistics of 135 operations with a mortality of 5.9 per cent. Pregnancy is interrupted by the operation in about 20 per cent. of cases (Flaischlen, *Zeitschrift für Geburtshülfe*, xxix. p. 49).

these, only two were anterior enteroceles; the others were lateral and posterior. The distention of the hernial sac in labor is apt to become excessive, and to threaten its rupture with protrusion of intestinal loops. An effort should be made to reduce the hernia as soon as it is discovered. The reduction may be facilitated by placing the woman in the knee-breast posture and by inserting the whole hand into the vagina. If this treatment is instituted in pregnancy, it should be followed by the insertion of a large tampon or a globe pessary and by prolonged rest in bed; in labor the presenting part should immediately be brought down past the hernial ring. If there are adhesions about the latter, preventing the reduction of the hernia, the tumor should be supported and held to one side by assistants while the child is artificially extracted by forceps or after version. Should the sac rupture and the intestines protrude, the child must be delivered hastily, the intestines be cleansed thoroughly and replaced, and the opening be sewed up. In the case of a very large irreducible vaginal hernia the writer's preference would be for Cesarean section in a labor at term.

Other growths or tumors in the pelvic inlet and cavity obstructing labor have been fibrocystic tumors of the ovarian ligament, requiring an abdom-

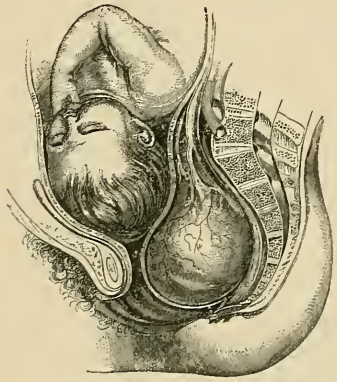

FIG. 67.—Ovarian tumor incarcerated in the pelvis during labor.

FIG. 68.—Cystocele obstructing labor.

inal section; fibroma of the ovary; sarcoma of the ovary; a displaced adherent kidney at the pelvic inlet, necessitating version and forcible extraction;* hydatid cysts of the pelvis, demanding Cesarean section; a displaced and enlarged spleen; masses of exudate; and an aneurysm of the gluteal artery.

Cystocele and rectocele should be replaced if they protrude to a great extent in front of the head, and be held back until a forceps is applied and the head is brought past them with the instrument (Fig. 68). Version and extraction have occasionally been found necessary. Large fecal masses in the rectum

* Runge reports four cases (*Archiv für Gynäkologie*, xli. p. 99). The writer has had one. Albers-Schoenberg reports another in which the uterus ruptured (*Centralblatt für Gynäkologie*, Dec. 1, 1894).

must be removed by an enema or must be dug out.* Calculi in the bladder should, if possible, be discovered and removed by the urethra or by vaginal lithotomy before the second stage of labor. They may become nipped between the head and the pubic bones, and pinch a hole through the anterior vaginal wall and bladder if they are overlooked or neglected.† The diagnosis of vesical calculus in the parturient woman appears to be somewhat difficult: it has been taken for a pelvic exostosis or some other pelvic tumor, and in one case at least Cesarean section was performed on account of this mistake. Fortunately, vesical calculus in the female is rare. In 10,000 women examined by Winckel in fifteen years it was found only once.

The following conditions in and about the rectum may present mechanical obstacles to delivery: Cancer, anus vestibularis or vaginalis, foreign bodies, contraction of the levator ani muscles, benignant tumors such as cysts of the rectum, ovarian cysts which have perforated the rectum, and retro-rectal dermoid cysts. Each of these conditions must be treated according to the individual indications. Incisions in the perineum may be required, foreign bodies must be removed, resisting muscles on the pelvic floor may be overcome by an anesthetic and by the application of forceps, and cystic tumors should be punctured or removed after ligation of their pedicles. Cancer of the rectum may demand the performance of Cesarean section by reason of the size of the tumor and the cicatricial infiltration of the birth-canal, as in Freund's case.

7. Obstruction in Labor on the Part of the Fetus.

Overgrowth of the Fetus.—Excessive overgrowth of the fetus is rare. The writer searched the records of more than 1000 children in the Maternity Hospital of Philadelphia before he found one that weighed more than twelve pounds; weights, however, of fifteen, sixteen, eighteen, twenty-three and a half, and twenty-eight and three-quarters pounds have been recorded. The causes of overgrowth in the fetus are prolongation of pregnancy, over-size and advanced age of one or both parents, and multiparity. Rarely it may be inexplicable. The first named is in the writer's experience the most common cause. In 6 per cent. of women pregnancy may be expected to be prolonged beyond the three-hundredth day, and for every day that the fetus is retained in the womb beyond the usual time there is commonly some little increase in its size and weight above the normal. So much difficulty and danger may be experienced from this cause that it is a good rule in practice to allow no woman to exceed the normal duration of pregnancy by more than two weeks. By induc-

* Corradi tells of a case in which seven pounds of hardened feces were removed before the woman was delivered.

† Kotschurowa has reported a case in which labor lasted three days. At the end of that time a gangrenous tumor protruded from the vulva, which tumor proved to be the bladder and anterior vaginal wall. The midwife in attendance perforated the tumor with her finger, whereupon a calculus eighty-five grains in weight was discharged (*Jahresbericht ü. d. Fortschr. a. d. Gebiete der Geburtsh., etc.*, vi. 225).

ing labor at that time one will occasionally interfere unnecessarily, but he will often avoid complications and difficulties of the most serious nature.

Over-size and advanced age of one or both parents may be a cause of overgrowth in the fetus—the latter usually because it predisposes to a prolongation of pregnancy. It is commonly asserted that the size of children increases in successive pregnancies up to the fourth or fifth, and then remains stationary or even decreases; but there are important exceptions to this rule. The writer has seen the tenth child vastly exceed in size the nine preceding; it weighed fifteen pounds, and it was necessary to deliver it by Cesarean section. The other children had been born naturally through a flat pelvis with a conjugate diameter of 9 centimeters. The increase in size of successive children must be borne in mind in cases of contracted pelvis. The first two or three infants may be delivered spontaneously, but the larger size of the fourth or fifth may make natural delivery impossible.*

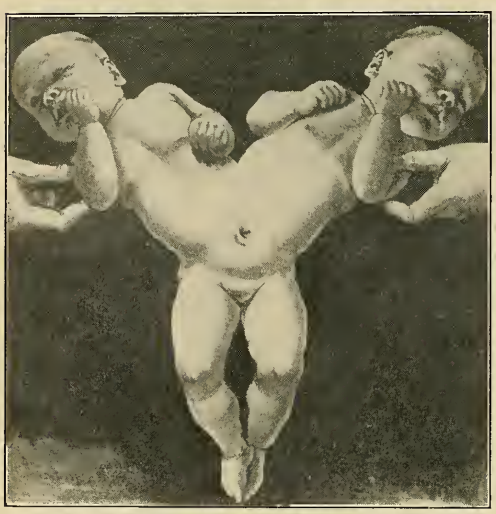

FIG. 69.—Dicephalus.

Overgrowth of the fetus is the most difficult condition in obstetric practice to diagnosticate with precision. A careful palpation of the head and body and an attempt to push the former into the pelvic inlet may give

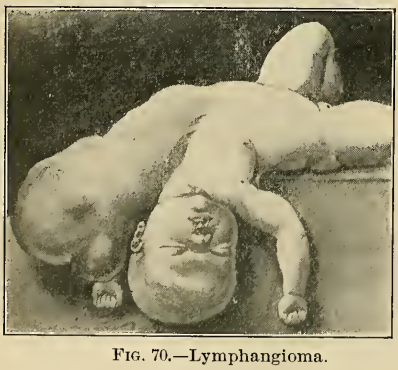

FIG. 70.—Lymphangioma.

FIG. 71.—Dicephalus.

* Lehmann in 712 labors through 198 contracted pelves found increasing difficulty in delivery with each succeeding labor. In first labors 50 per cent. ended spontaneously; in second, 43.8; in fourth, 38.4; in fifth, 33⅓; and in labors after the fifth only 9.8 per cent. (*Inaug. Dis.*, Berlin, 1891).

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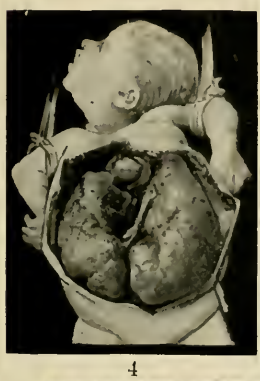

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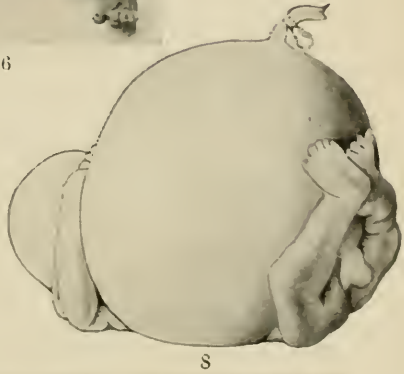

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1. Diprosopus (Hirst and Piersol). 2. Diprosopus (Fleming). 3. Dicephalus. 4. Large cystic kidneys (Fussell). 5. Large meningocele and spina bifida (Hirst and Piersol). 6. Congenital cystic elephantiasis (Wilson). 7. Thoracopagus (Hirst and Piersol). 8. Distended bladder (Ahlfeld).

one an approximate idea of the relative size of fetal body and pelvic canal, but as a matter of fact the large size of the fetus is usually discovered in practice only after prolonged delay when attempts at artificial delivery, especially by version, have failed. By this time the fetus is commonly dead, and should be delivered by embryotomy. But the practitioner must be on his guard against futile attempts to deliver an infant too large, even when mutilated, to pass through the pelvis. The writer has seen in consultation practice several maternal deaths due to this cause.

FIG. 72.—Craniopagus.

Premature Ossification of Cranium; Wormian Bones; Large Heads; Malformations and Tumors of the Fetus.*—No single rule of treatment can be laid down for the management of these cases. Forceps, version, or some form of embryotomy is usually demanded. Spontaneous labor, however, is possible even in cases of monstrous bulk in which delivery through the birth-canal would seem out of the question. Thus in double monsters joined loosely by the front or

FIG. 73.—Ischiopagus.

* Dr. Grace Peckam (*New York Medical Record*, April 14, 1888) has reported three still-births, attributed in each instance to the development of Wormian bones in the smaller fontanelle, and to the consequent interference with overlapping of the cranial bones at the sutures. This observation has not yet been verified by others.

back (xiphopagus, the Siamese twins; pygopagus, the Hungarian sisters), one child will be born by the head, the other afterward by the breech, or *vice versâ*. In dicephali one head may be pressed into the neck of the other or may rest

FIG. 74.—Dipygus (Wells).

FIG. 75.—Dipygus parasiticus.

upon the iliac bone till the first head makes its escape from the vulva. Even in thoracopagus, the commonest double monstrosity, in which two trunks are

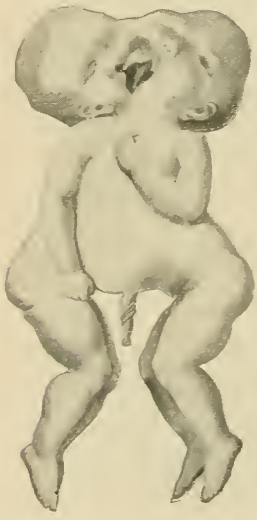

FIG. 76.—Prosopothoracopagus.

FIG. 77.—Xiphopagus.

intimately joined front to front (Pl. 37), spontaneous labor is possible by the mechanism shown in Figures 82 and 83. On the other hand, the great-

est difficulty may be encountered in labor, and the most serious operation may be demanded to deliver the woman.*

FIG. 78.—Janiceps.

Fetal tumors obstructing delivery may be hydrencephaloceles, lymphangiomata, myxomata, sacral teratomata. Cystic tumors should be punctured. Solid tumors may call for ver-

FIG. 79.—Myxoma of neck (Longaker).

FIG. 80.—Sacral tumor (Mütter Mus., College of Physicians).

sion or for embryotomy. Craniotomy may be required in monstrous enlargement of the cephalic extremity, as in syncephalus or in diprosopus. Decapitation may be necessary in duplicity of the cephalic extremity, as in dicephalus or in thoracopagus. In Reina's case of tricephalus the first head was perforated and then amputated, the second was perforated, crushed, and amputated, and the third was amputated.

Diseases and Death of the Fetus.—All diseases of the fetus that increase its bulk may constitute thereby an obstruction in labor. Cystic tumors, effusions in the serous cavities, anasarca, an enlarged liver, polycystic disease of the kidneys,[21] and distended bladder from atresia of the urethra † are examples. Liquid accumulations should be evacuated by puncture or by incisions.

FIG. 81.—Anasarca.

Hydrocephalus (Pl. 38) is the most important condition under this head. It

* There are two recorded deliveries of thoracopagi by Cesarean section (Hirst and Piersol, *Human Monstrosities*).

† Schwyzer (*Arch. f. Gyn.*, Bd. 43) has collected 13 cases of dilatation of the fetal bladder from atresia of the urethra, stenosis of the urethra, and obstruction of the urethra by a valve-like formation of mucous membrane. Müller reports a case and quotes another (*Arch. f. Gyn.*, Bd. 47, H. 1).

is not very rare,* is often overlooked, and is a frequent cause of ruptured uterus. The *diagnosis* can be made by a vaginal examination, by abdominal palpation, and by a combined examination, or, if necessary, by anesthetizing the woman, introducing the whole hand into the vagina, and thoroughly palpating the enlarged head resting above the pelvic brim. The wide-open fontanelles, the great width of the sutures, the fluctuation to be felt perhaps in these regions, the large size of the head appreciated by bimanual examination, and possibly the abnormal mobility of the cranial bones, and in some cases their extreme tenuity, indicate the condition. Hydrocephalus is very often overlooked in practice as the result usually of a careless, superficial examination. A painstaking and methodical investigation of a suspected case should avoid this error. There are cases, however, in which there is no increased width of the sutures, no enlargement of the fontanelles, and such slight enlargement of the head that it cannot be appreciated; and yet the fluid contents of the cranium

FIG. 82.—Mechanism of labor with dicephalus.

FIG. 83.—Mechanism of labor in thoracopagus.

prevent compression of the skull and make the engagement of the head impossible. The writer has seen one such case. Hydrocephalus should always be suspected if the head in labor remains above the brim, although the pelvis is normal in size and no good reason can be found for the failure of engagement.

The treatment of labor obstructed by hydrocephalus is puncture of the cranium with a perforator and evacuation of its fluid contents. A child with this disease deserves no consideration. After the reduction in the size of the head the labor may be left to the natural forces. If these prove insufficient, a cranioclast may be fastened to the skull and the child be extracted artificially. A cardinal rule in the treatment of these cases is to avoid attempts to deliver with forceps—a common error in practice, and one that has cost many a woman her life from ruptured uterus, from deep tears when the instrument slips, as it will, and from extensive sloughs after delivery.

* Schuchard found it sixteen times in 12,055 births; Lachapelle and Dugés, fifteen times in 43,555; Merriman, once in 900. In 159 cases there were 38 maternal deaths, twenty of which were from rupture of the uterus.

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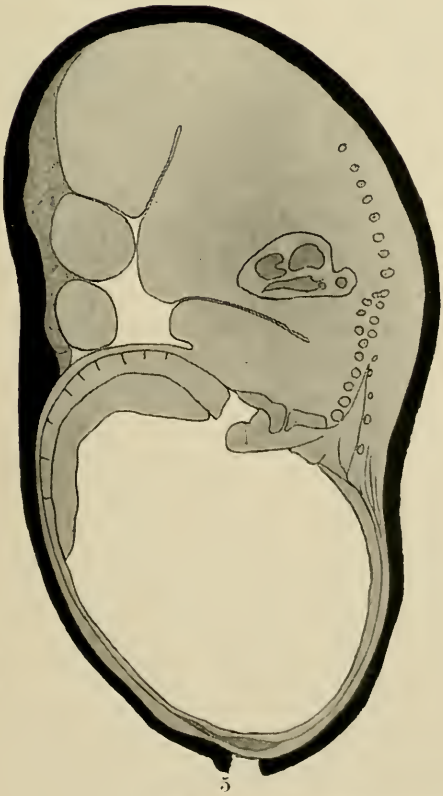

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1. Skeleton of hydrocephalus (Hirst Collection, University of Pennsylvania). 2. Hydrocephalus (Hirst). 3. Hydrencephalocele posterior (Hirst and Piersol). 4. Hydrencephalocele superior. 5. Hydrocephalus distending lower uterine segment (Varnier). 6. Tapping a hydrocephalus through the spinal canal.

If the pelvic extremity of the hydrocephalic fetus presents—as it does in almost a third of all cases—and if the head remains inaccessible above the superior strait, so that it cannot easily be punctured, the spinal canal may be opened, a catheter be passed through it into the cranial cavity (Van Huevel's method), and the fluid thus be evacuated (Fig. 84). Usually, however, there is no special difficulty or danger in the delivery of the after-coming head of a hydrocephalic infant. The force required for its extraction not infrequently ruptures the walls of the ventricles and converts the case into one of external

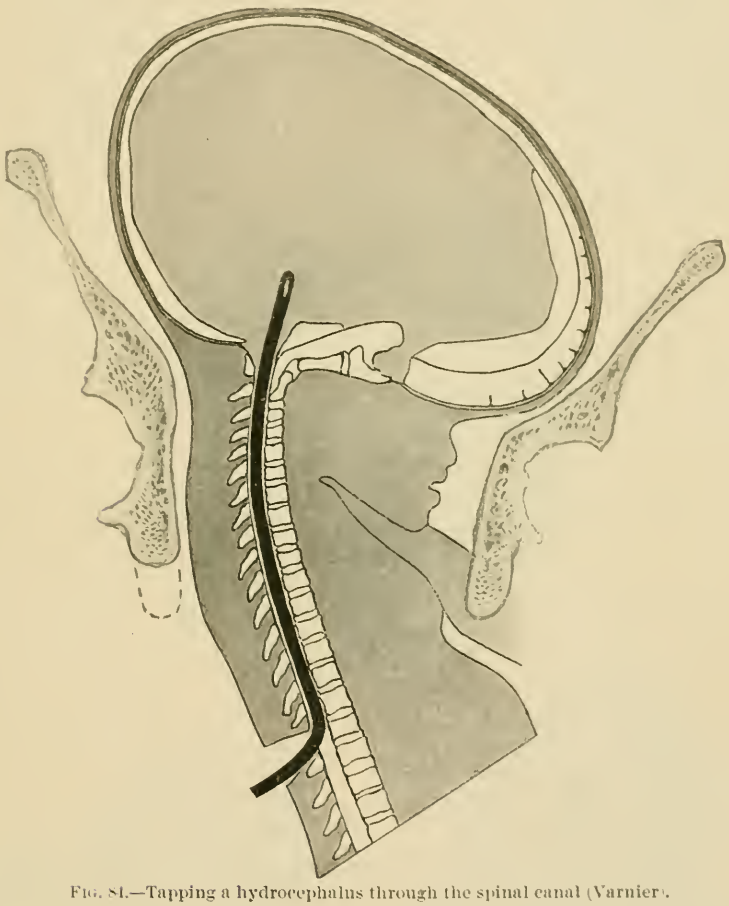


Fig. 84.—Tapping a hydrocephalus through the spinal canal (Varnier).

hydrocephalus, or possibly drives the fluid out of the foramen magnum into the tissues of the neck and back, so reducing the bulk of the head as to permit its extraction. At any rate, the condition can scarcely escape the notice of the medical attendant, and a diagnosis is made before the lower uterine segment is dangerously stretched or ruptured.

The difficulty in the delivery of a hydrocephalic fetus is not in direct proportion to the quantity of fluid in the ventricles and the size of the head. In cases of extreme distention the cranial vault is likely to rupture, while in

moderate grades of hydrocephalus the quantity of brain-substance surrounding the ventricles and the strength of the brain-membranes forbid this means of spontaneous delivery.

Malpresentations and faulty positions (Pl. 39) include shoulder, face, brow, deviated vertex, and compound presentations. All but the last are considered elsewhere. By compound presentation is meant the presentation of two or more parts at the same time, as a head and a hand, a head and a foot, a hand and a foot, nuchal position of the arm, or the head and all four extremities.

A compound presentation is met with about once in 250 labors. It is usually a head and a hand. The following table is furnished by Pernice from 2891 births in the clinic at Halle:

Hand and head	26
Arm and head	8
Hand and umbilical cord	5
Both hands	4
Foot and hand	2
Two hands, umbilical cord, and foot	1
Face, hand, and cord	1

Kietz found in 7555 labors the foot and head presenting in twenty-three.[25]

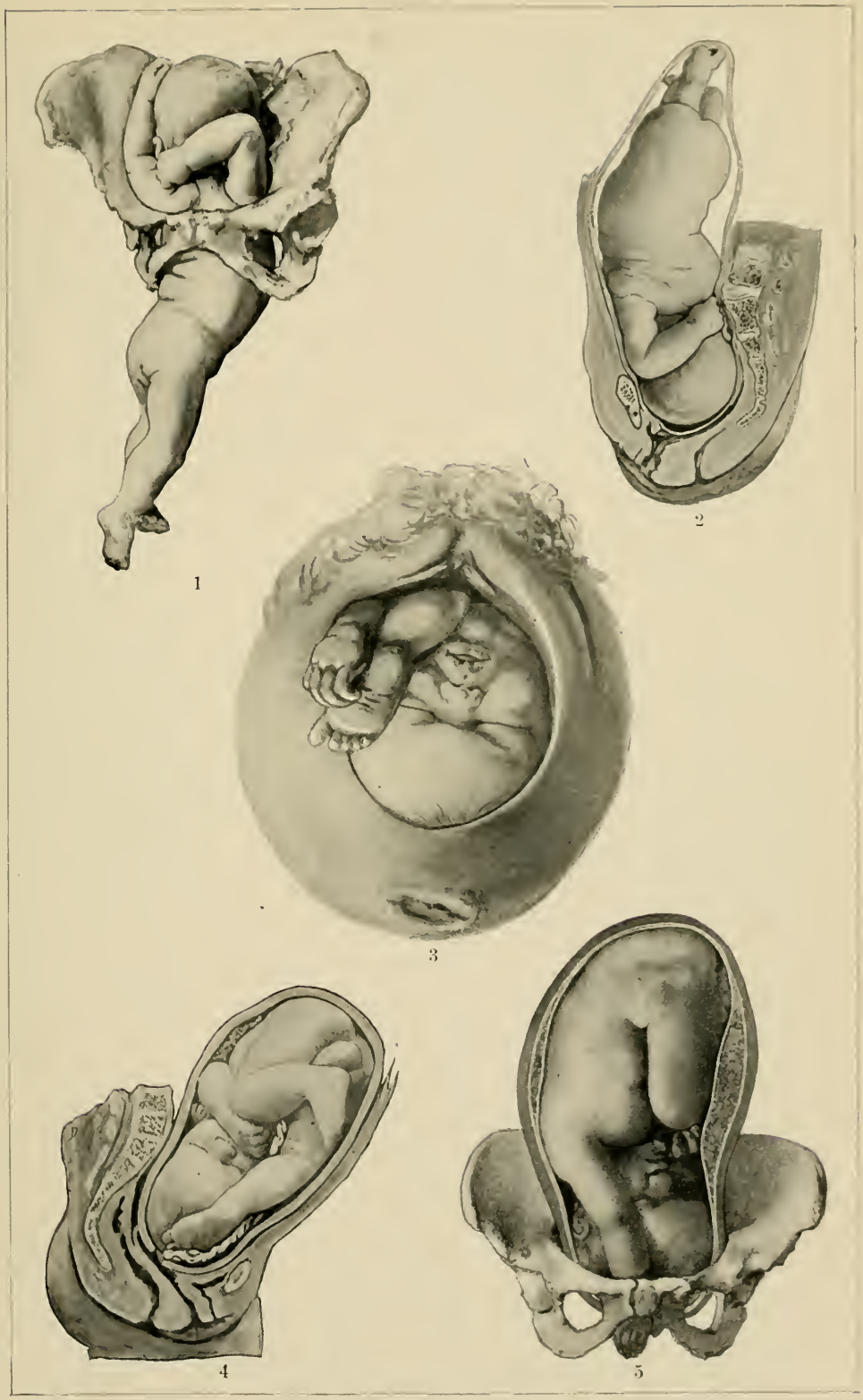
The cause of compound presentations is usually a lack of conformity in the presenting part with the pelvic inlet (as in malposition of the fetus), a head of abnormal size, a displaced uterus, twins, hydramnios, contracted pelvis, and anomalous shape of the uterus, etc.

In the *treatment* of compound presentations before rupture of the membranes an attempt should be made to overcome the difficulty by postural treatment. The woman should be placed on that side opposite the prolapsed extremity. After rupture of the membranes an attempt should be made to dislodge the prolapsed extremity and to restore it to its natural position. Version may, however, be required if this attempt fails, or even craniotomy if the child is dead. If the head and extremities present, and if the former is engaged, it is usually best to apply forceps and to disregard the prolapsed extremities. In the case of nuchal position of the arm an effort should be made to dislodge the latter, but it may be necessary to fracture it before the delivery of the child can be secured.

Multiple Births.—Twin labors are usually easy and uncomplicated (75 per cent.), but complications are more frequent than in single labors. Malpresentations are common (Pl. 40). The following table from Spiegelberg, based on 1138 labors, gives the combined presentations in the order of their frequency:

Both heads presenting	49 per cent.
Head and breech	31.70 " "
Both pelvic presentations	8.60 " "
Head and transverse	6.18 " "
Breech and transverse	4.14 " "
Both transverse	.35 " "

It may be noted that a transverse position is found in 10.67 per cent. of cases. Mechanical difficulties in labor are frequent, the uterine muscle is usually weakened by overstretching, and there may be trouble in the third stage of



1, 2. Nuchal position of arm. 3. Compound presentation (Ahlfeld). 4. Compound presentation (Hirst). 5. Compound presentation.

weakened by overstretching, and there may be trouble in the third stage of labor in the delivery of the placenta. Some form of operative interference is demanded in about 25 per cent. of all cases.

In the majority of cases (79 per cent.) the interval between the delivery of

FIG. 85.—Impaction of heads in twin labor.

FIG. 86.—Locking of heads in twin labor.

twins is less than an hour. A longer delay than this indicates the likelihood of some obstruction to the birth of the second infant or a failure of expulsive forces.

Serious difficulty in twin labors may arise in one of three ways: Both heads present at once, one a little in advance of the other, the second impacted in the neck of the first (Fig. 85); the first child descends by the breech, and the head of the second child is caught by the chin of the first and pushed into the pelvis (Fig. 86); one child sits astride of the other, which is transverse. If both children should be found attempting to engage by the head in the superior strait at one time, one child should be retarded while the other is artificially extracted. If this is impossible, the first head should be extracted by forceps, the second be treated in like manner, and then the trunks should be delivered one after the other. Embryotomy is a last resort, but is scarcely ever necessary.

FIG. 87.—Entanglement of cords in twins (Winckel).

A coiling of the cords (Fig. 87) and their entanglement may be a source of difficulty and delay in unioval twins. It may be necessary to cut one or both cords between ligatures before the children can be delivered.

In case one child presents by the head and the other by the feet, both may come down together, and the two heads become locked in the pelvic entrance and canal. An effort may be made to push back the child presenting by the head. If this succeeds, the child presenting by the breech should be extracted immediately, for it is in imminent danger from asphyxia. It

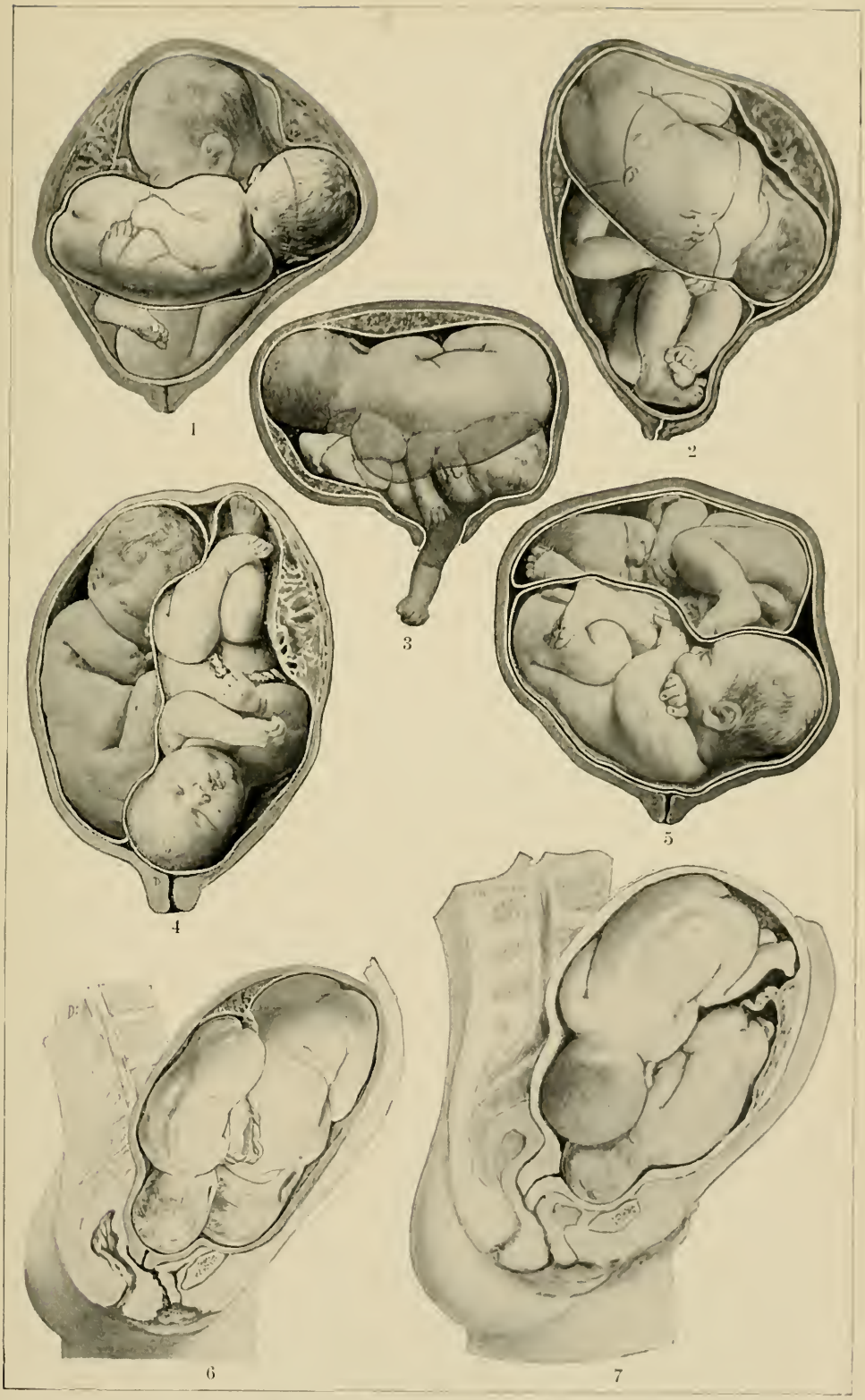
may be possible with forceps to pull the child presenting by the head past the body of its fellow presenting by the breech. Failing in these attempts, the child presenting by the breech will almost surely have died and there will be no pulsation in its cord. It should then be decapitated, whereupon the infant presenting by the head can be extracted without difficulty by forceps.

In any case of twin labor, as soon as the first child is born, and the cord, ligated with a double ligature, is cut, the attendant should immediately investigate the position and presentation of the second child. A neglect of this rule leads very often to the impaction of an unrecognized shoulder presentation in the second child, and its consequent death. If an abnormality is discovered in the presentation of the second child, it should at once be corrected. Then, after waiting perhaps half an hour, the amniotic sac should be ruptured, and ergot may be administered in a full dose to secure a speedy delivery, or, if the stomach will not retain it, the hypodermatic syringe should be used, for, the birth-canal having been dilated thoroughly, there is no obstacle to the birth of the second infant in twin labors, and consequently no objection to the employment of ergot, which not only hastens the conclusion of labor, but promotes subsequent contraction of the much-distended uterus, and so prevents post-partum hemorrhage. As a further precaution against this accident the fundus should be compressed for a long time after birth by the nurse.

FIG. 88.—Twins, head and breech (modified from Hunter).

There may be difficulty in the delivery of the placentæ in twin labors. Commonly the children are born first and the placentæ afterward. Their bulk may make expression difficult, and it is often necessary to make some traction upon the cords—first upon one and then upon the other—to determine which placenta will come first and to assist in its expulsion. Occasionally one and rarely both placentæ may be expelled after the birth of the first child. In a case of the writer's the placenta of the first child, prolapsing in front of the second, necessitated a difficult forceps operation for the extraction of the second. On account of the frequent and extensive anastomoses between the vessels of the placentæ in unioval twins it is a necessary precaution to tie the cord of the first child with a double ligature and to cut it between the ligatures; otherwise the second infant might bleed to death.

The *prognosis* of twin labors is always doubtful. There are so many possible dangers for both mother and children that multiple labors must be regarded



1, 2. Twins, transverse and breech. 3. Twins, both transverse. 4. Twins, head and breech. 5. Twins, both transverse. 6, 7. Twins, both heads presenting.

as distinctly pathological. Albuminuria in the mother is the rule in multiple pregnancies, and eclampsia is ten times more frequent than in single births.* There is a disposition to inertia uteri during and after birth from distention of the cavity, and consequently a likelihood of post-partum hemorrhage. Some operative interference or intra-uterine manipulation is called for in about 25 per cent. of cases, and this, in addition to the frequency of kidney insufficiency, predisposes to sepsis. Finally, there may be insuperable obstruction in labor if locked twins are not managed properly, and the woman may die of ruptured uterus or of exhaustion. The maternal mortality in the Budapest Maternity was four times as great as in the single births, and Kleinwächter's statistics give a mortality of 13 per cent. For the children there is greater danger than for the mother. Twin pregnancy is almost always prematurely interrupted, and even if it is not the children are, as a rule, under the normal size and weight. There is always the possibility that the development of one child at least will be seriously interfered with by the lack of room in the uterine cavity. Hydramnios of one sac and oligohydramnios of the other are not uncommon. In labor there are the frequent complications from malposition, operative interference, entanglement of or pressure upon the cords, and more rarely the engagement of both bodies at once in the pelvic canal. In Kleinwächter's and Kézmárszky's statistics the fetal mortality was nearly 40 per cent. Of 38 children in cases of locked twins, only six survived—a mortality of 84 per cent.

Cases are on record in which an extra-uterine fetus has obstructed the delivery of the intra-uterine twin. It has been necessary to make a vaginal incision through which the former was extracted before the latter could be born.

Death of the fetus during or before labor, followed by rigor mortis, has proven a source of obstruction in labor by the rigidity of the child and the consequent interference with the normal mechanism of its delivery, and especially of the shoulders and trunk.[25] Ankylosis of the large joints of the extremities may have the same effect to a less degree.

Labor Complicated by Abnormalities in the Fetal Appendages.—*Membranes.*—If the membranes are too thin, they may rupture prematurely, and thus give rise to what is called a "dry labor," in which the birth-canal must be dilated by the hard, unyielding presenting part instead of by that conservative hydrostatic dilator, the bag of waters. Such labors are longer and more painful than the average, and there is a greater likelihood in them of lacerations in the cervix and a more frequent demand for an artificial termination with forceps. If the membranes are too thick, they rupture late, being preserved perhaps until the child's head presents at the vulvar orifice, or even until the complete escape of the head from the mother's body. In these cases the head and face are covered by the membranes as though by a veil, and care must be taken to free the mouth and nose quickly, that respiration may be instituted without interference. The membranes thus covering the head and face are spoken of as a "caul." It is possible for the whole ovum to be extruded unbroken at term. The writer has seen this occur as late as the sev-

* Of 627 cases of eclampsia, 69 were multiple pregnancies (Winckel).

enth month, and, as stated, it is actually recorded at the full period of gestation.

Difficulties in labor may be encountered in consequence of an abnormality in the quantity of liquor amnii. If there is too little, the labor has the same clinical features as though there had been a premature laceration of the membranes. If there is too much liquor amnii, there may be inertia as the result of overstretching of the uterine muscle-fibres.

Umbilical Cord.—If the umbilical cord is too short, it may cause premature detachment of the placenta or may prevent the advance of the child. The *diagnosis* of a short cord in labor is always difficult. It may be suspected, however, if there is exaggerated pain at the placental site, marked recession of the head after each pain, and an obvious retardation of labor

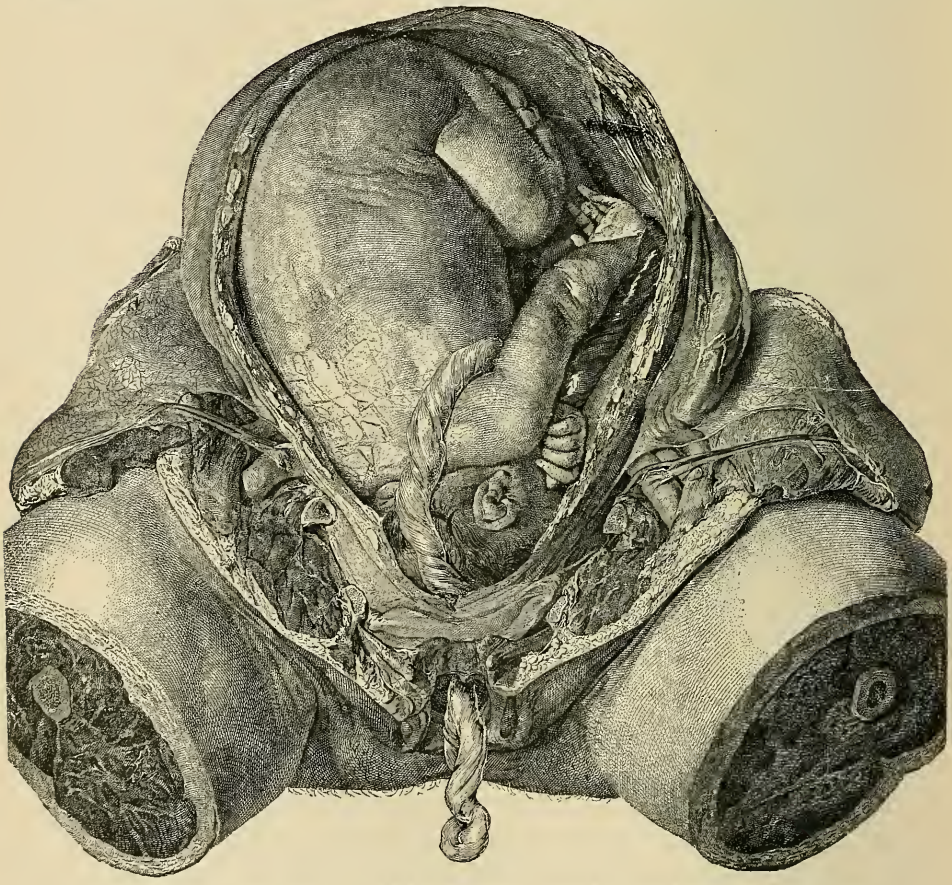


FIG. 89.—Umbilical cord, caught in the axilla, encircling the shoulder and prolapsed (Hunter).

without other ascertainable cause. Forceps should be applied in such a case if the presentation is cephalic. If the cord is too long, it may possibly prolapse should there be other conditions in the labor favorable to such an accident; or it may be coiled about the child's neck, trunk, or extremities, and may consequently be fatally compressed during labor (Fig. 89).

Obstruction of a mechanical character in labor on the part of the placenta

is seen only in placenta prævia and in prolapse of the placenta. The placenta may be adherent as the result of syphilitic or other inflammation of the endometrium during pregnancy, and, becoming partially detached in the third stage, may cause alarming hemorrhage. It is very commonly simply retained in the lower uterine segment or in the vagina, whence it may be expressed by the proper application of Credé's method. In some cases the atmospheric pressure obstructs the delivery of a retained placenta so effectually that it is necessary to hook one's finger over the edge of it, to allow the access of air behind it, before its expression is possible. Retention of the placenta may be due to its great bulk, as in twin placentæ, or to tumors increasing its size. In such cases it may be necessary to extract the placenta manually.

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2. Dystocia due to Accidents and Diseases.*

1. Accidents to the Umbilical Cord.

The cord usually measures about 20 inches, but it may have twice or thrice that length, or may even be longer. In consequence of this increased length prolapse is liable to occur. Great length of the cord at least permits more or less numerous coils or "circulars" of the funis about the fetus or its members. In consequence of these circulars the cord may be shortened, or there may be a natural shortness of the cord. The cord has been known not to exceed 10 centimeters (4 inches) in length, but most generally its shortness results from its coiling around the fetal parts. This brevity, whether natural or accidental, interferes with labor, and may cause conditions more or less grave to the child and to the mother, for a ruptured cord, a detached placenta, or even an inverted uterus, may be among the accidents resulting from the anomaly. Complete absence of the cord has been observed, the vessels passing directly from the abdomen of the child to the adjoined placenta. The reason is therefore plain for including in a single group anomalies of, and accidents to, the cord.

Prolapse of the Cord.—By prolapse is meant descent of the cord with, or in advance of, the presenting part of the fetus. The prolapsed loop may be felt mobile in the waters when the membranes are unruptured; or, the amnial liquor having been discharged, the loop may be in the vagina; or, finally, it may be external to the vulva (Fig. 89). Thus there are three† varieties of prolapse, though some authorities describe the first variety as presentation of the cord. The second variety of prolapse may be met with though the first was not observed or even did not occur, the loop having suddenly been carried into the vagina by a free discharge of amnial liquor. In most cases the two halves of the loop are in apposition, but in some cases the presenting part may intervene. Thus in presentation of the head one half of the loop may be on one side and the other half on the other side of the presenting part; or in presentation of the pelvis the cord may be between the thighs.

The frequency of prolapse of the cord is variously stated. According to Winckel, clinics give from 1 in 65 to 1 in 500; this accident is oftener observed in hospital practice than in private practice.

Etiology.—The essential *cause* of prolapse of the cord is want of correspondence between the presenting part and the lower portion of the uterus, for if the former fully occupies the space, there will be no room for the cord. Among causes that contribute to this accident are great length of the cord; the woman standing or sitting when the membranes rupture; an excessive quantity of amnial liquor; smallness of the fetus; multiparity; implantation

* The *superior* figures ([1]) occurring throughout the text of this article refer to the bibliography given on page 160.

† The classification made by Jacquemier, *Manuel des Accouchements*, 1846, has been adopted.

of the placenta in the lower portion of the uterus; marginal attachment of the cord; pendulous abdomen; plural pregnancy; the birth of a male; a complex presentation—as, for example, descent of a hand with the head; presentation other than of the vertex or the face; and, more important than any of these, narrowing of the pelvis. Kaltenbach[1] remarks that prolapse of the cord in presentation of the head occurring in a primipara should always excite suspicion of a narrow pelvis. Predisposition has also been mentioned as a cause, the accident having been observed in successive pregnancies; but, of course, to admit predisposition as a cause no other obvious cause must be present. Roper[2] has given a case in which the accident occurred in three successive pregnancies, but there was notable lessening of the conjugate. The prolapsed loop usually descends in front of one of the sacro-iliac joints or in front of the cotyloid cavity, and rarely directly anterior or posterior.

The diagnosis of prolapse of the cord can immediately be made if the membranes have ruptured and the loop is in the vagina, and still more readily if the cord is external to the vulva. A mistake in either case would seem impossible; but with the membranes intact and with the pulsation absent the diagnosis is more difficult. The obstetrician feels with his fingers, in the interval of uterine contraction, a soft, floating body, the thickness of a finger; he can define it as the cord by hooking his finger in the loop and pressing it against the presenting part or against the uterine wall: if pulsation is detected, there is no possibility of doubt. Winckel[3] called attention to the fact that if, in auscultating the fetal heart, the sounds become slower, there is probable pressure upon the cord, and an examination may lead to the discovery of prolapse of the cord.

Prognosis.—Danger to the mother is exceptional in prolapsed cord. In consequence of the cord being stretched tightly over the head of the child, or, in pelvic presentation, of the child being astride of the cord, there may be such an accidental shortening of the cord that detachment of the placenta with hemorrhage results. Moreover, the operations which the prolapse may require in its treatment—manual or instrumental reposition, podalic version, or extraction with the forceps—are not to be regarded as trivial matters and without peril to the mother, although that peril is slight. The danger to the child, however, is very great. Probably it is correct to give the mortality as not less than 40 per cent.

The danger to the fetus is compression of the cord, death resulting from asphyxia. The danger varies also with the presentation, being greatest in that of the head, but much less in shoulder or breech presentation. Early prolapse is more unfavorable than late prolapse. If the cord is implanted upon the margin of the placenta and the placenta occupies a low position in the uterus, or if the insertion is velamentous, or the pelvic contraction (a factor in causing the disorder) is great, the prognosis is more unfavorable than when opposite conditions are present. Finally, the amount of the prolapsed portion and the part of the pelvis in which it descends should be considered.

Treatment.—If it is certain that the child is dead, a purely expectant plan of treatment is indicated in prolapse of the cord. The diagnosis of death, however, should be made, not solely from finding the cord pulseless, for pulsation may be absent in it for several minutes and yet the child be alive, but by careful and repeated abdominal auscultation. Again, if the prolapse is simply a complication of placenta prævia or of shoulder presentation, the treatment of the essential disorder is first in importance, and it may prove best, too, for the complication. In ordinary cases restoration of the prolapsed cord, if this be possible, is the obstetrician's first duty.

In the first variety or degree of prolapse, frequently called "presentation of the cord," the patient should be recumbent and great care should be taken to avert early rupture of the membranes. It will be better for the patient to lie upon the side opposite to that on which the prolapse occurs, and her head should be low. Hicks advises that the patient assume the knee-elbow position and that entrance of air into the vagina be secured. Placing the patient in the Trendelenburg posture is a very efficient postural method of treatment. It protects the cord from pressure and facilitates the manipulations employed for replacing the cord.

In the second degree of prolapse—namely, a loop of the cord in the vagina —if the pulsation is good, the cord being at the side of the head, in front of one of the sacro-iliac joints, and the descent of the head being rapid, so that spontaneous delivery will speedily occur, it is better to wait, interference with forceps, for example, being determined by the pulsations in the cord becoming feebler or ceasing. La Motte, whose rule in cases of prolapsed cord was podalic version,[4] gives a graphic account of one of his cases ending favorably for both mother and child. He did not discover that the cord had descended until he found it in the vagina, and the uterine action was so great and constant that he could not attempt to turn. In his *Reflexion* he observes that probably his "ignorance was the safety of the child."

FIG. 90.—Improvised repositor.

If speedy delivery, either spontaneous or instrumental, is impossible, reposition of the cord is indicated. This replacement is postural, manual, or the two combined. Instrumental reposition might have been included, but there is no instrument equal to the hand for this purpose. A moderately firm catheter or bougie, with a loop of string or tape passing through the eye of the catheter and an opening made directly opposite the eye, or tied over the end of the bougie (Fig. 90), can be employed to replace the prolapsed cord. If necessary, the catheter may remain in the uterus, holding the prolapsed cord out of the way until the labor is ended. If the postural method is employed, the patient is put in the knee-elbow or Trendelenburg position. The hand may also be used at the same time, as advised by Kaltenbach, but it is preferable, if manual assistance be required, that the patient should be upon the side, or upon an impro-

vised Trendelenburg table, for then only can anesthesia fully and satisfactorily be employed. Braxton Hicks gives the following directions: "The anesthetic having been given, the patient remaining in the ordinary lateral obstetric posture, one hand is placed over the abdomen and the position of the child's head is made out. This may be done by separating the thighs and passing the hand, preferably the right, between them. The left hand, having its back greased, is passed into the vagina, and, gathering the funis together, carries it past the head, which is at the same time pressed sufficiently aside. When the funis is restored, the external hand presses the head down, and the fingers inside receive it and adjust it in the os. Six or more labor-pains having occurred, the internal hand may be removed, although it might have earlier been removed, and reintroduced to feel if the funis is still up. The patient can then be placed on her back, while the outer hand is kept a little longer to secure the adaptation of the lower uterine zone to the head."[5]

The writer has two remarks to make in regard to the method suggested by Hicks. The use of the left hand for replacing the cord, the patient being upon her left side, is suitable if the prolapsed loop of cord be upon the right side of the pelvis, but if the funis has descended upon the left side, then the woman should be in the right lateral position, and the right hand is the preferable one for introduction, while the left hand is used externally. Further, when the cord is restored it is well to hook it over some part of the child, the knee, for example, or pass it above the chin: the method of placing the cord over one of the lower limbs to prevent its again falling was probably first recommended in 1786 by Croft.[6] By whatever method the cord has been replaced, prolapse is very liable to recur. So great, indeed, is this liability that some classic writers on obstetrics have compared its restoration with the task of the Danaides and with that of Sisyphus.

Manual and instrumental reposition having failed, podalic version best meets the emergency of prolapsed cord. Spiegelberg[7] takes the ground that it is not well to spend too much time in trying to replace the cord, such efforts in themselves disturbing the umbilical circulation, and perhaps injuriously affecting the subsequent course of the uterine contractions.

After version the question of immediate delivery will be determined by the condition of the fetal circulation, for if this remains good it is better to leave the expulsion of the child to the forces of nature. Winckel advises, in shoulder presentation complicated by prolapsed cord, immediate extraction after version, because the latter can hardly be effected without great pressure upon the cord. If in pelvic presentation the child is astride of the cord, an effort should be made to draw down enough of the loop to permit its being passed over one thigh: if the loop does not permit this lengthening or if there is dangerous stretching, it is better to divide the cord.

Coils or Circulars of the Cord.—The cord encircles the fetus once in about every six cases of delivery. These coils or circulars—adopting the equivalent of the French *circulaires* as applied to this condition—are much more frequently about the neck of the fetus, but they may be around the body

or around the members. There may be one or several circulars; for example, the cord, while usually around the neck once or twice only, may encircle it six, seven, or even eight times. The optimism of Jacquemier led him to believe that *circulaires* were a wise provision against prolapse of the cord. This anomaly is generally associated with great length of the cord, but in some cases the length is normal, and in a very few it is less than normal.

Etiology.—Winckel[3] mentions as causes of circulars a long cord, a large quantity of amnial liquor, the yielding uterine walls of multiparæ, marginal and velamentous insertion of the funis, and smallness of the child. Of course the movements of the fetus are the immediate cause of the anomaly. Chantreuil observes[8] that experience does not confirm the opinions of Michgorius, Mme. Boivin, and others, who attribute circulars to the excessive movements of the mother.

The injurious results of circulars, so far as labor is concerned, usually arise from brevity of the cord—a brevity which is then called "accidental," though by many the adjective "relative" is applied to the condition to distinguish it from "absolute" brevity. The accidents resulting from shortness of the cord will be considered in the next section.

Natural or Accidental Shortness of the Cord.*—By natural shortness of the cord is meant that the length measured from the umbilicus to the placental insertion is insufficient to permit expulsion of the child without rupture of the cord, placental detachment, or uterine inversion. Accidental shortness, usually arising from coils about the neck of the child, is similarly defined, except that the point of the fetus from which the measurement is taken is no longer the umbilicus, but is the neck.

It is evident that the length of the cord will vary, in case of absolute brevity, with the degree to which it can be stretched, and in accidental brevity with this elasticity, and also with the tightness of the coils caused by the strain. Further, the point of placental attachment, either in the upper or the lower part of the uterus, and the insertion of the cord, whether marginal or central, must also be taken into consideration. Matthews Duncan[9] assumed that "it is impossible to make a quite exact statement of the length of any cord while proving itself a cause of difficult labor." Lamare says, accepting the statement of Negrier that the length of the genital canal at the time of expulsion of the fetus is 22 centimeters ($8\frac{3}{4}$ inches),[10] that true brevity begins at 25 centimeters (10 inches), and that only below this length does the cord inevitably cause accidents.†

Shortness of the cord does occur, notwithstanding the scepticism of Dewees,‡ though the instances of it are infrequent. The consequences of this

* Most authors use the terms *absolute* and *relative*, but the writer thinks that the adjectives which he here employs are preferable.

† Kaltenbach (*Lehrbuch der Geburtshülfe*, 1893) states that if the placental insertion of the cord is at the fundus 35 centimeters is too short, while in deeper insertion 20 centimeters is sufficient.

‡ "I shall not positively deny the existence of such a condition; but I must say I have never seen an instance, and also that I entertain strong doubts of its possibility."—*Compendious System of Midwifery*, 8th ed., Philada., 1837.

condition are painful, protracted labor; impossibility of spontaneous delivery; there may be fatal pressure upon the cord, or it may be torn and there may be hemorrhage from detachment of the placenta, and even inversion of the uterus. Rigby gives an instance of a cord which was only 2 inches long being torn at its placental insertion, the delivery being spontaneous. Kales[11] delivered with the forceps in a case in which there proved to be accidental shortening of the cord. On making traction during a pain he found there then occurred a notable depression at the fundus of the uterus, the depression disappearing when the traction ceased—one of the signs of this anomaly, according to some authorities, although denied by others. Werder[12] reports a case in which, the child being delivered with forceps, the cord was found torn at the umbilicus, and with it a large circular flap of skin: the cord was less than 4 inches long. Felkin[13] narrates a case of spontaneous delivery in which the cord, $5\frac{3}{4}$ inches in length, was torn and the placenta was expelled with the child, severe hemorrhage occurring. In a second case of accidental shortness of the cord, there being five coils about the neck and one around the body, the delivery was spontaneous and inversion of the uterus occurred. Dyrenfurth of Breslau,[14] in a case of hydrocephalus, punctured the head and delivered it with the cranioclast; there was then delay in extracting the shoulders, and when this difficulty was overcome and the labor was ended it was found that the cord, which measured but 3 centimeters, was torn half a centimeter from the umbilicus. Malgouyre had a patient in labor at term, and immediately after the rupture of the membranes the child and placenta were expelled, the cord being found to be 2 inches and 8 or 9 lines in length. In a case reported by Leroux[15] the umbilical cord was so short after the escape of the fetus that the umbilicus was closely applied to the vulva, and the child could not be taken away until the placenta was expelled.

It has been established by Negrier[16] that if there be accidental shortening of the cord because of a loop around the neck, partial delivery may occur, the child breathing, and then, unless suitable assistance be rendered, the child will be strangled from constriction by the cord. Mackness,[17] in a case of placenta prævia, after performing podalic version, bringing down one foot, and finding the hemorrhage not arrested, brought down the other foot; after extracting the body further progress was arrested because of the cord passing between the child's legs. It was necessary to cut the cord before the head could be delivered.

Diagnosis.—The signs usually given of brevity of the cord are severe pain at the place of the supposed placental attachment; depression of this part during a uterine contraction or when traction is made with the forceps; marked recession of the head in the interval of contractions, this recession being greater than can be attributed to the resistance and elasticity of the lower part of the birth-canal; irregular discharges of blood; and arrest of pains. Napier[18] regards uterine inertia as a more important diagnostic sign than retraction of the head. Dr. King,[19] who has made several important contributions on the subject, states as a characteristic sign that the patient has a persistent desire to sit up.

Coils about the body may be known in some cases by auscultation, in still rarer cases by abdominal palpation. Haake was the first (in 1865) to discover coils around the neck by rectal touch. But the only certain way to ascertain that there is shortness of the cord is to feel it and actually to know that it is tight and stretched. This may be done in breech presentations, when the child is astride of the cord or after the breech is born, by passing one or two fingers up to the umbilicus, and finding, by pulling toward the placental end, the cord so taut that it is impossible to draw any part of it down. In presentation of the head, after expulsion as far as the umbilicus, a similar method of examination may also be employed. Hicks [9] narrates a case in which he made the diagnosis of short cord; after the delivery of the breech he had to divide the cord before the rest of the child could be born. The cord proved to be but 4 inches long.

Treatment.—In regard to the treatment of shortness of the cord but little can be said. Roederer, and many obstetricians since his day, urged the importance of pressing the uterus downward, the obvious benefit of which, of course, is to bring the placental attachment nearer the fetus. King [19] seeks to accomplish the same object indirectly by having the woman "take a kneeling, sitting, or squatting position, or by so elevating the shoulders that she is placed midway between lying upon her back and sitting." In connection with Dr. King's method the following citation from Denman [20] is of interest:

"If the child should not be born, when we have waited as long as we believe to be proper or consistent with its safety or with that of the parent it will be requisite to change her position, and, instead of suffering her to remain in a recumbent one, to take her out of bed and raise her upright to permit her to bear her pains in that situation; or, according to the ancient custom of this country, to let her kneel before the bed and lean forward upon the edge of it; or, as is now practised in many places, to set her upon the lap of one of her assistants."

It is better that the child should be delivered by pressure, fetal expression, than with the forceps. Instrumental delivery is the last resort. Of course, when a short cord is discovered, which will usually be only after partial expulsion of the fetus, the cord should be divided. When, in accidental brevity of the cord, the strain is not relieved by cutting the cord or by removing one or more of the coils over the head, the child is usually delivered by what Duncan [21] terms a movement of spontaneous evolution: "in consequence of the strain upon the cord the fetus so revolves that its anterior surface is brought to look forward." Duncan adds that in cases of coils about the neck this revolution is in a direction to undo partially the encircling, and thus to lessen the strain upon the cord, and that this part of the evolution may artificially be performed to aid the delivery.

Rupture of the Cord and of its Vessels.—The cord may be torn or there may be rupture of one or more of its blood-vessels; in other words, there may be complete or partial rupture. Some illustrations of ruptures of the cord have been given in the preceding section. This accident occurs most frequently in

consequence of absolute or accidental shortness, omitting those cases in which the obstetrician tears the cord in an effort to extract the placenta. The strength of the funis has been the subject of experimental study. The experiments of Duncan and Turnbull [21] show that the average resistance of the cord to a strain on it is eight and a quarter pounds, the weakest cord yielding to five and a half pounds, and the strongest to fifteen. The experiments of Lamare [8] prove that in order to rupture a cord of 50 centimeters by a weight falling 25 centimeters, it is sufficient that this weight may in the mean equal 1500 or 2000 grams, and it may even be as small as 660 grams. He has shown also that the living cord—that is, the cord having its vessels filled with warm water—breaks with a slightly less force than the dead cord.

It is evident that, as has repeatedly been proved, the cord may be torn simply by the weight of the child, expulsion taking place while the mother is erect or even semi-erect. Moreover, there are instances of the cord giving way in childbirth while the woman was lying in bed. Spaeth's case * illustrates this: In a primipara, the first stage of labor being tedious and the second stage lasting but half an hour, a violent contraction occurred while the midwife was placing a cushion under the patient's hips, and the child was driven out a distance of 50 centimeters from the genital organs. The cord, thick, gelatinous, and friable, was broken: it was 30 centimeters long, and the rupture was in its middle. Budin [22] has given a similar case: The patient, a secundipara, made violent expulsive efforts, and the child was rapidly expelled. The cord, which encircled one of the thighs of the child, was torn 10 centimeters from the umbilicus: its entire length was 42 centimeters. Budin [23] has also given a case in which the weight of the placenta, which was suddenly expelled and fell to the floor, ruptured the cord near the umbilicus. The attendant, while waiting for the pulsations in the funis to cease before ligating, was surprised by the abrupt discharge of the placenta from the genital canal.

In several instances the cord has been ruptured at the umbilicus by the attempt to remove circulars from the neck.

Cases are recorded of partial rupture, the tear involving only the vein or the vein and one of the arteries: the tear being also in the sheath of the cord, the hemorrhage is external, but when the sheath is entire the blood may form a hematoma of the cord. McDougall [24] found in the cord, 2 inches from the umbilicus, a collection of blood the size of a hen's egg. Kirkpatrick [25] recorded a very remarkable case of thrombus in the cord: "The funis formed a loop the sides of which were adherent to one another, and in consequence of the pressure on the curve of the loop during labor a clot formed and the circulation stopped in the funis." Hamill [26] reported a case of fatal hemorrhage from a large branch of the umbilical vein running across the fetal surface of the placenta, a considerable mass of coagulated blood being found beneath the amnion. Velpeau [27] attributes ruptures of the blood-vessels to disease causing dilatation, "small aneurysmal or varicose pouches," and he states that he has "seen these

* Quoted by Lamare: *Klinik der Geburtshülfe und Gynäkol.*, 1885. Chiari, Braun, and Spaeth.

dilatations torn at term, and communicating with a large clot which covered a part of the placenta and which had not ruptured the amnion."

In velamentous insertion of the cord, while, according to Winckel, 18 per cent. of the children perish from asphyxia resulting from compression of the vessels of the cord, a still larger proportion die from rupture of these vessels. Spiegelberg states that occasionally the obstetrician ruptures the cord while performing version, and even oftener during extraction. It is established that the cord ruptures more frequently at the fetal than at the placental end, and also that "spirals and vascular anomalies are weak parts, and the cord is peculiarly liable to tear at these points." Hemorrhage is much less likely to occur from a torn than from a cut cord. In 183 cases of torn cord collected by Klein there were twenty-one in which the cord was ruptured at the umbilicus, and in none of them was there bleeding. Nevertheless, in exceptional cases of ruptured funis there may be considerable bleeding both from the fetal and from the placental end.

Treatment.—The treatment of ruptures of the cord is chiefly prophylactic. Remembering the causes of this accident, the obstetrician will endeavor to avert them, and he will thus prevent the patient from being delivered in other than a recumbent position, unless in quite exceptional cases, and he will not permit too rapid escape of the fetus. When the cord is accessible to touch and is so tense that tearing is threatened, he will divide it; furthermore, he will prefer to sever the coils about the neck of the child, rather than to use force for the removal of one or more of the coils. In velamentous insertion of the cord he will delay rupture of the membranes as long as possible, and if one or more of the vessels should be torn, he will deliver the child as soon as possible. In case the child is born and the cord is found torn, ligation is advisable even though no hemorrhage be present. As has been stated, almost all tears at the umbilicus do not bleed, but should they do so, the vessels are to be drawn out with a tenaculum and tied. This method was successfully employed by Braxton Hicks.

2. Dystocia due to Hemorrhage.

Placenta Prævia.—If the placenta, in whole or in part, be implanted in that portion of the uterus which must be dilated for the passing of the child, it is called "prævia." The lower segment of the uterus in pregnancy is half of a spheroid; in labor this hemispheroid must be changed into a canal or hollow cylinder having a diameter of about 11 centimeters (4½ inches). By the lower segment of the uterus is meant that portion bounded below by the internal os; its upper boundary is from 2½ to 3 inches above, measuring along the uterine wall. In this lower segment occur the pathological phenomena of placenta prævia.

Hegar[28] in 1863 stated that too extensive formation of the serotina may cause the placenta to project into the area of expansion of the uterus. In 1890, Hofmeier[29] concluded from the examination of the uterus of a woman dying in the fifth month of a twin pregnancy that in "most if not all cases"

placenta prævia originated from the development of the placenta within the reflexa of the lower pole of the ovum. Figure 92 represents admirably this view. Upon examining the illustration it will be noticed that a part of the reflexa upon which the placenta has formed is not yet united with the vera. Kaltenbach[30] states that "by preparations from early periods of pregnancy Hofmeier and the author have proved that in placenta prævia the development of the placenta takes place within the reflexa of the inferior pole of the ovum." The under surface of the presenting placenta is covered with smooth reflexa which later is united with the opposite vera.

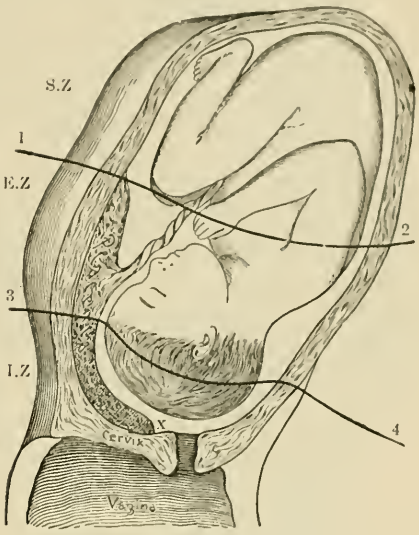


FIG. 91.—Partial placenta prævia. The uterus is divided into three zones: thus, 1, 2, is the line which marks the boundary between S.Z, the superior zone, and E.Z, the equatorial zone; 3, 4, is the line ("Barnes' boundary-line") which marks the limit between the equatorial zone, E.Z, and the inferior zone, I.Z. *X* is the prævial flap of the placenta, upon which the head rests (Barnes).

The explanation of the origin of placenta prævia given by Hofmeier and Kaltenbach has been accepted by many obstetricians, among whom may be mentioned Olshausen and Martin; but there are some who dissent—for example, Ahlfeld, Winckel,* Berry Hart, and Gottschalk.[31] Hart, in expressing his dissent, gave the following statement: "I must now state the view I advocate for the occurrence of placenta prævia. It is that of primary implantation of the impregnated ovum low down, or even over the os internum. The forcible objection that Kaltenbach urges against this view seems to me not quite valid. He holds that the small ovum would pass into the cervical canal and be lost. We must remember, however, that the hypertrophied and folded decidua there will practically obliterate the os internum, and thus implantation over it may occur. But why should such a low implantation happen? We only know that it is more apt to occur in cases where the mucous membrane has been unhealthy. The hypothesis I would advance, but merely as an hypothesis, is that the human ovum can graft only on a surface denuded of epithelium, and that thus it does not graft in the Fallopian tube, but in some part of the uterine cavity where the epithelium has been removed by menstruation. If, then, the ovum does not meet with the connective-tissue surface until it has passed low down in the uterine cavity, some form of placenta prævia will happen."

* Winckel remarks, referring to the views of Hofmeier and Kaltenbach: "Ahlfeld has justly disputed the correctness of this explanation, and from a case in which the placenta was entirely situated in the lower uterine segment has given ground for the old opinion of the primary grafting of the ovum in the inferior third of the uterine cavity" (*Lehrbuch der Geburtshülfe*, 2d ed., 1893).

Dr. Robert Barnes first announced in 1847 his theory of placenta prævia, and he has made several contributions to the subject since, the most recent of these being a paper read by him in 1892 before the International Congress of Diseases of Women and Obstetrics, in Brussels. In justice to one of the most eminent and able obstetric writers and teachers, as well as in justice to the theory itself, which certainly was an important advance, and from the fact that the practice founded upon that theory is upheld by some obstetricians, prominent among whom is Murphy of Sunderland,—the latest public exposition of his views is here presented. The paper referred to being in French, a translation of a part is here presented. Dr. Barnes, after having stated that his theory is represented in Figure 91, proceeds as follows:

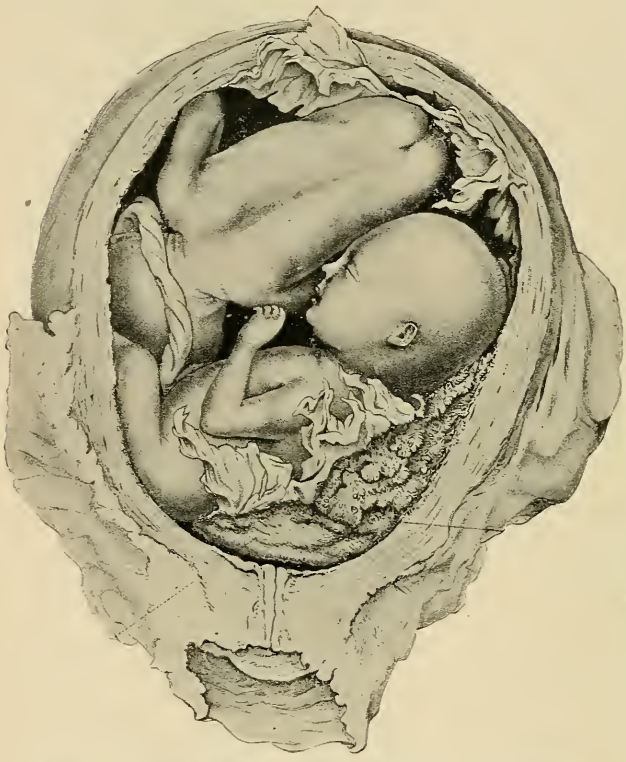


FIG. 92.—Placenta prævia in pregnancy with twins (Hofmeier).

"It is seen from the illustration that the uterus is divided into three zones:

(1) The superior or fundal zone;
(2) The equatorial or middle zone;
(3) The inferior zone.

The superior zone is separated from the equatorial by an imaginary line (1, 2) which may be called the 'superior polar circle.' This line, it is true, has not been anatomically demonstrated. But it serves to mark a distinction, which I believe real, between the characters of the superior and equatorial zones in their relations to the placental attachments and to hemorrhage.

"The equatorial zone is separated from the inferior zone, otherwise called the inferior uterine segment, by the line 3, 4. This line is the line of demarcation of Barnes, Barnes' boundary-line (1847–1857). This line was called 'the internal os of Braune' in 1872; it became the 'ring of Bandl' in 1876; and later, the 'contraction-ring' of Schroeder. It may also be called the 'inferior polar circle.'

"The superior zone (S. Z.) is the seat of fundal placenta; it is the safest region of attachment. The equatorial zone (E. Z.) is the seat of lateral or equatorial placenta. The lateral placenta may give place to that form of hemorrhage called 'accidental;' nevertheless, the equatorial zone may be considered as site of attachment normal and safe. This security is still greater when the placenta is attached in part in the superior zone and in part in the equatorial zone. The danger begins when the placenta is attached in part in the inferior zone—that is, when there is partial placenta prævia. The portion of the placenta which encroaches upon the inferior zone (I. Z.) is liable to premature separation. Complete placenta prævia, called also *placenta prævia centralis*, is found when the entire placenta or the greater part of it is attached in the inferior zone and covers the internal os.

"In the last case the gestation would be, justly speaking, an ectopic gestation (or out of place), for the ovum, or an important part of it, is developed in the inferior zone of the uterus, a part which is not designed by nature for this function. The curved line traced in the inferior zone marks the position of the fetal head. The line of demarcation (3, 4) corresponds almost exactly

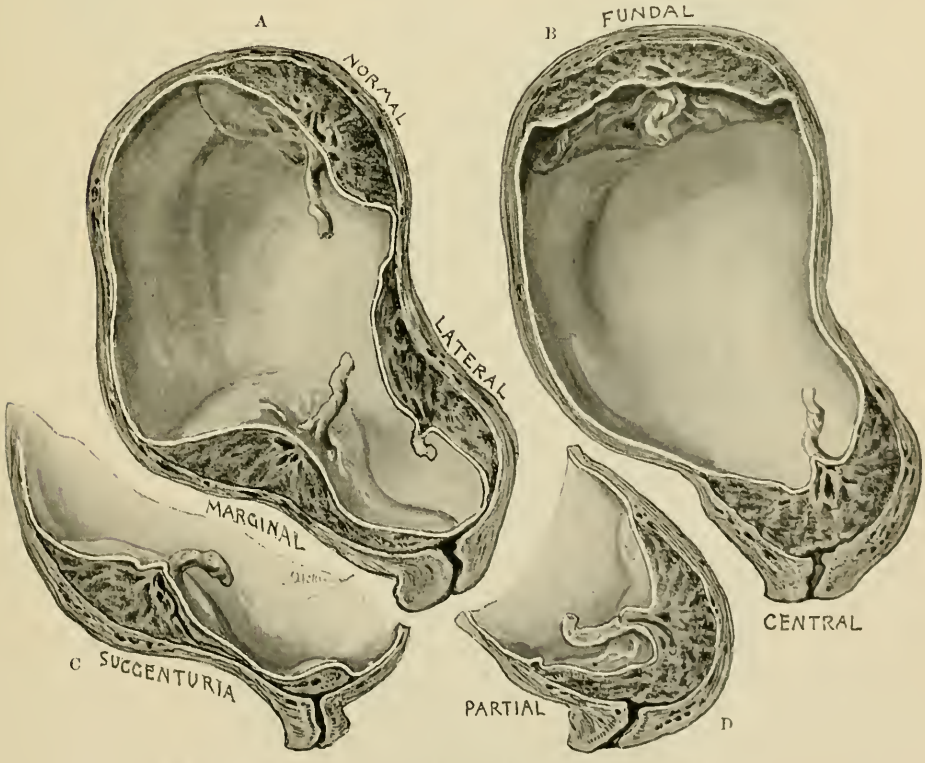


FIG. 93.—Varieties of placenta prævia: in A there are seen the normal, lateral, and marginal implantation; in B there are represented the implantation of the placenta at the fundus, which is rare, and implantation over the internal os; in C lateral implantation and that of a cotyledon immediately over the internal os; and in D partial implantation.

with the equator of the fetal head, and often it nearly corresponds with the entrance of the pelvis."

Varieties of Placenta Prævia.—The accompanying illustration (Fig. 93) shows different forms of placental implantation in the lower portion of the uterus, and the names applied to them, and also implantation at the fundus and at the fundus and side. Some confusion has arisen from giving so many varieties, and from differences in the application of terms designating them. Thus, one author calls that "partial" which another names "lateral," illustrating the ambiguity which comes from what Lord Bacon spoke of as "the unsteady use of words." The writer thinks it better, as Schroeder, Budin, and some others have done, to make but two varieties, *complete* and *lateral.* By complete placenta prævia is meant that condition in which the internal os is entirely covered by placenta. It corresponds with what many others have called "central implantation of the placenta;" that is, the centre of the placenta is supposed to be directly over the internal os. Pinard[32] stated that in 15,000 accouchements he never met with the insertion centre for centre, consequently he has the right to say that this variety is exceedingly rare. Lateral implantation of the placenta includes those cases in which the great mass of the placenta is at the side of the uterus, a margin more or less near the internal

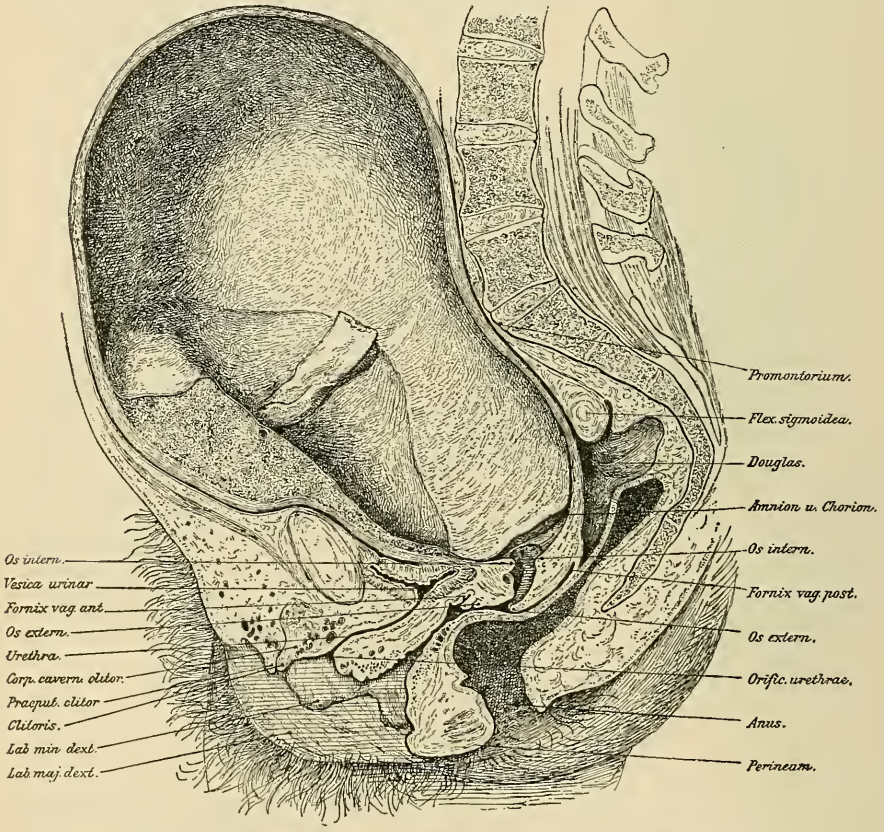


FIG. 94.—Placenta prævia: child removed, placenta remaining (Winter).

os; indeed, in some cases the margin may partially extend over the os. The lateral variety is much the more frequent.

Figure 94 shows a not infrequent condition, a single cotyledon over the os, while the great mass of the placenta is at the side: the first is known as placenta succenturiata.

Authorities generally agree that lateral is much more frequent than complete or central placenta. Nevertheless, Trask [33] gives 169 of the complete to 88 of the lateral, and Müller's statistics, which include those of Trask, show a slight predominance in favor of the complete variety. Read's statistics [34] show a similar result. Unfortunately, in many of the cases given by Read there is a failure to state the placental presentation, and some others are described as "almost complete" or "nearly complete," and hence uncertain conclusions only can be made. Müller has shown that in complete placenta prævia the smaller lobule was situated at the left in thirty-seven out of 56 cases. In

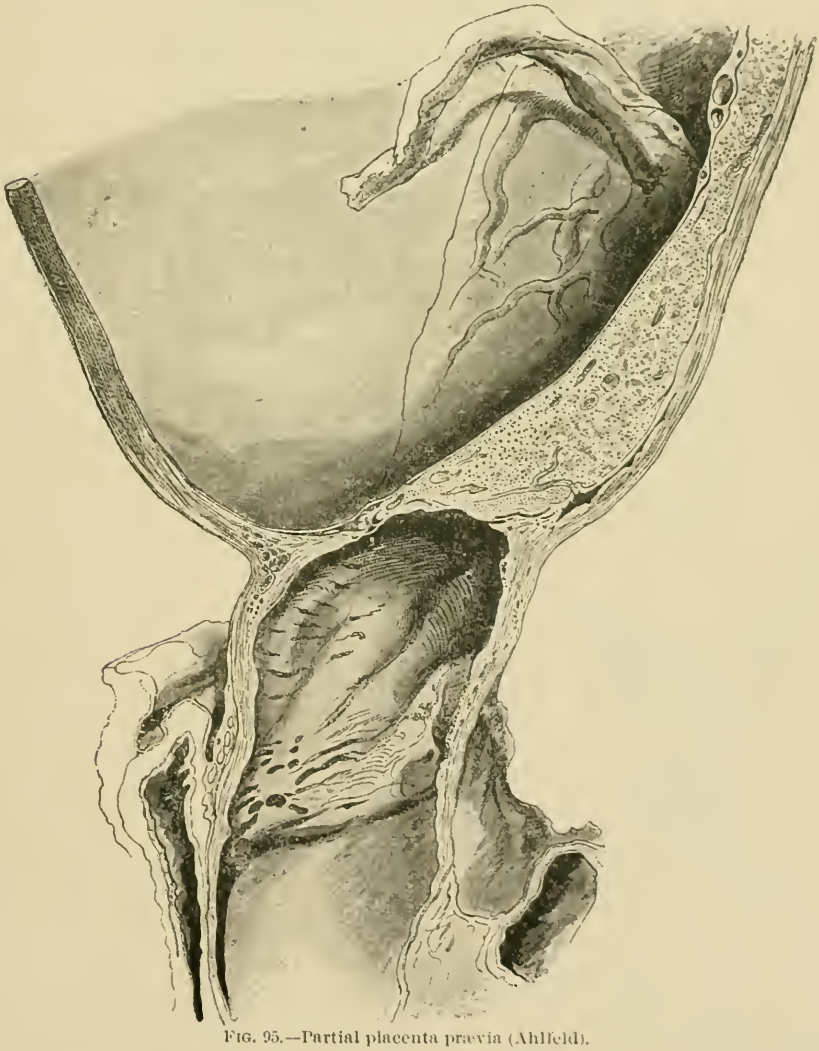


FIG. 95.—Partial placenta prævia (Ahlfeld).

lateral placenta prævia the placenta is in 50 cases at the right side to 31 at the left side. As will be seen, there is a correspondence between these results.

Frequency.—The proportion of cases of placenta prævia to the entire number of deliveries is usually given as 1 to 1000, 1 to 1500 (Winckel), and 1 to 1500 or 1600 (Kaltenbach). Pazzi[35] gives the proportion of 1 in 748. As illustrating how misleading limited statistics may be, we quote the statement of Townsend[36] as to cases of placenta prævia in the Boston Lying-in Hospital: In the last twenty years there were 28 cases of placenta prævia in 6700 deliveries. Thus there was 1 case of placenta prævia in 239 labors, or more than 4 in 1000. Of course, as Townsend remarks, there are more cases of this anomaly in hospital than in private practice, but still such a large proportion as he found is not the expression of a general truth. No age is exempt, for placenta prævia has occurred in a girl of thirteen years and in a woman of fifty. It is most frequent from thirty to forty years, for out of 248 cases 127 of the subjects were in that ten years (Müller).

Anomalies of the Placenta when it is Prævia.—The placenta is not oval, but is irregular in form; the prævial placenta extends over a larger surface, but is thinner, than the placenta having a normal site. A placenta succenturiata is not infrequent, or, again, the placenta may be composed of two lobes, and the bridge of tissue connecting these lobes may be directly over the os; hence an error in diagnosis is possible. The form of the placenta presents other varieties.[37] Thus it has been found in the shape of a half-moon or a horseshoe, or it is pyriform or cordiform; Gilroy[38] described one as lozenge-shaped, the cord being attached to one of the angles.

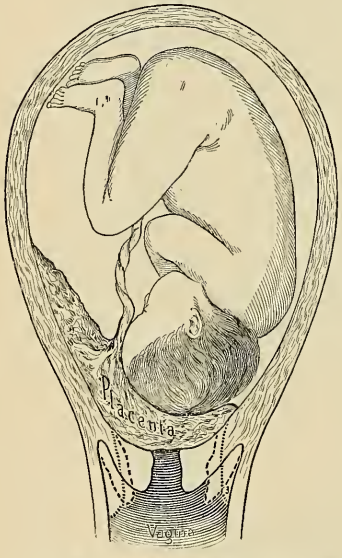


FIG. 96.—Partial placenta prævia, vertex presentation: the os beginning to dilate (Lusk).

In placenta prævia there are frequently abnormal adhesions between the placenta and the uterine wall. Müller found such adhesions in fifty-four out of 142 cases, and Sabarth of Reichenbach in seven out of 14 cases. This condition may cause more or less serious delay and difficulty in the third stage of labor, and of course it gives a certain liability to infection. The insertion of the cord in many cases is marginal and sometimes is velamentous. Depaul[39] directed attention to the fact that the membranes in placenta prævia seem thickened as if infiltrated, and, further, that the chorion presents externally quite characteristic rugosities which alone suffice, even when the placenta cannot be felt either by its surface or at its border, to authorize one in affirming that the placenta is near.

Causes.—Spiegelberg[7] states that previous abortions predispose to placenta prævia, and that it is more frequent in the poorer classes, possibly owing to hard work at the beginning of pregnancy, and still more to the subinvolution of the uterus which is so common in this class. So

far as the first statement is concerned, it seems to the writer that both abortions and prævial placenta should be attributed to a common cause, a diseased condition of the endometrium. The accident is more frequent in multiparæ than in primiparæ—two- or three-fold (Winckel)—and according to Müller[37] 85 per cent. are multiparæ. Anomalies of the uterus, such as uterus *bicornis* and *unicornis*, cancer and myoma of the uterus, relax-

Fig. 97.—Central placenta prævia, the os partly dilated (Hunter).

ation of the uterine walls, opening of the oviducts in the lower part of the uterus, as in two cases reported by Ingleby, and, more important than most and more frequent than any of these, endometritis with hypersecretion, are causes of placenta prævia.

Osiander[40] believes that lying on the back favors insertion of the placenta at the fundus, lying upon one side favors a lateral attachment, and standing

or sitting favors implantation over the os; hence he considered lying on the back or on one side, continued some time after copulation, as necessary for a fortunate situation of the ovum. Stein and others attribute the origin of placenta prævia to the specific gravity of the ovum. Müller states that others accuse conception during menstruation or while the uterus has a more vertical position, thus coitus while standing, as a chief ground.

In 1874, Angus Macdonald[41] reported a case of twin pregnancy, the fetuses being transverse and each placenta presenting at the internal os. He regarded placenta prævia with twins as a very rare anomaly, and asserted that "the expectation of the concurrence of twins with placenta prævia is only 1 in 44,500 cases of labor," and that, of course, the probability would be much less with both placentæ presenting. Müller found it rare in plural pregnancy, but Barnes has spoken of it as not uncommon, and Winckel states that plural pregnancy predisposes to placenta prævia, the accident in his experience being relatively four times more frequent in plural than in single pregnancy.*

Reamy[42] suggests that placenta prævia may originate in sexual intercourse being deferred until fifteen or sixteen days after menstruation for the purpose of avoiding conception. If this delay were a cause, probably the number of cases would be much greater. Pinard has asked if travelling early in pregnancy, with consequent jolting in railroad cars or in carriages, may not cause placenta prævia. The recurrence of placenta prævia in the same subject has been observed. The cases recorded by Ingleby are explained by the abnormal point of entrance of the tubes into the uterus. Fitzpatrick[43] reports the case of a woman thirty-six years old who had nine pregnancies, the first four normal and ending in the birth of living children at term; in five successive pregnancies she had placenta prævia.

Symptoms and Diagnosis.—The most characteristic symptom of placenta prævia is hemorrhage occurring in the latter part of pregnancy or at the beginning of labor without obvious cause. The hemorrhage frequently begins when the patient is sitting quietly or even when lying asleep in bed. Lomer found in only thirty of 136 cases that the first hemorrhage was caused by some bodily exertion, such as lifting, straining, or coughing. Müller mentions coition as a cause. Winckel states that in lateral placenta prævia the first hemorrhage generally occurs after the thirty-second week, and in the central variety between the twenty-eighth and the thirty-sixth week. In rare cases not only of lateral but also of central implantation of the placenta there is no bleeding until a few days before labor, and in still rarer cases not until labor begins. Since Rigby's admirable essay[44] the hemorrhage occurring in placenta prævia has been called "unavoidable," while that which may happen when the placenta occupies its normal site is known as "accidental." In 1873, Matthews Duncan[45] took the position that

* One of the most remarkable cases of placenta prævia is that given by W. J. Harris (*Lancet*, 1863). A woman was twice pregnant with twins, and in each pregnancy had placenta prævia.

the hemorrhages occurring during pregnancy on account of placenta prævia were not unavoidable, but accidental, their occurrence being promoted by the unusual conditions present, and especially by increased blood-pressure resulting from the lower position occupied by the placenta. Yet those who have read the essay of Rigby will remember that he referred only to the hemorrhages of labor, in case of placenta prævia, as being unavoidable.

While not many years distant some authorities regarded the hemorrhage as placental, it is now usually conceded that it is uterine, and should the child die its death would be not from loss of blood, but from asphyxia. From the fetal circulation may come a small quantity of blood in case the chorionic villi are torn. Why the bleeding occurs in the latter part of pregnancy is a question that has had different answers. Jacquemier held, on the one hand—and his view, with qualifications, was accepted by Depaul—that the development of the lower part of the uterus was more rapid than that of the placenta, hence detachment of the latter; on the other hand, Legroux asserted that the placenta grew more rapidly than the uterus, that is, grew away from the uterus. Barnes has been especially prominent in upholding the latter view. Spiegelberg, first referring to placenta prævia predisposing to abortion, said: "Owing to the loose vascular connections of the placenta and to the higher blood-pressure in the placenta when inserted low, any shock is liable to cause rupture of its vessels and detachment; perhaps, also, shocks affect the lower portion of the uterus oftener than the upper during the first months of pregnancy (coitus, especially straining at stool). For the same reasons premature labor, too, is relatively common; indeed, I am convinced that even the hemorrhages which occur during the latter months of pregnancy depend upon commencing labor—that it is not the hemorrhages which induce premature labor, as is generally supposed, but that the converse relation is the true one."

The hemorrhage is not only abrupt and apparently causeless in occurrence—though this first hemorrhage may be fatal—but usually it ceases after lasting a few hours, or even in less time, and often spontaneously. The hemorrhage returns at irregular intervals, and is greater, occurs earlier, and is more frequent in those cases in which the placenta completely covers the os.

Auvard[46] mentions as symptoms unfavorable presentation of the fetus—presentations other than those of the head * are found in from 20 to nearly 50 per cent. of cases, according to different authorities—the occurrence of premature labor, and premature rupture of the membranes. Winckel remarks that in the relation of the funis in placenta prævia there is also offered a certain predisposition to bleeding. He states that Scanzoni, Hugenberger, and the author found marginal and velamentous insertion of the cord frequent.

Hemorrhage occurring in the last two or three months of pregnancy without obvious cause, and especially if the patient has not albuminuria, would at once suggest the strong probability that it resulted from placenta prævia.

* Of course the frequency of abnormal presentations is in part to be attributed to the fact that in many cases labor is premature.

Spencer[47] claims that it is possible by abdominal palpation to determine the site of the placenta when it is situated in the upper part of the uterus, and also by this means, on finding it absent from its usual site, it may be discovered in the lower portion of the uterus.

In examining the patient she lies upon her back, the bladder being previously emptied. The examination should be gentle and be made in the absence of pains, and should be prolonged over several minutes or be repeated if necessary. Spencer gives the following additional directions: In an ordinary vertex presentation (placenta in the upper segment) the occiput, forehead (at a higher level), and side of the head may under favorable circumstances be felt distinctly in the lower segment of the uterus by means of abdominal palpation. In a case of placenta prævia in which the head presents the head is not felt where the placenta is situated; it is distinctly felt where the placenta is absent. In cases where the placenta is in front the organ is felt as an elastic mass, of the consistence of a wetted bath-sponge, that keeps the examining finger off the head. The edge of the placenta may be felt, and has the shape of a segment of a circle. Within the circle all is obscure to the touch; outside the circle the head or other part of the child is plainly felt. Impulses to the head are not clearly felt through the placenta; impulses to the head through the placenta are distinctly felt at the spot from which the placenta is absent. The same applies to combined vaginal and abdominal examination.

Vaginal examination shows great softening of the cervix, and the bluish discoloration is well marked, extending to the external genitals. The pulsation of vessels in the lower part of the uterus and vagina is distinct. The presenting part of the child cannot be recognized distinctly through the uterine wall and the overlying placenta. Probability becomes certainty * only when the finger can enter the os or penetrate the cervical canal, and the sponge-like structure of the placenta can be felt. We distinguish *complete* from *lateral* placenta prævia by the finger touching in the former placental tissue at all parts surrounding the internal os, while in the latter the membranes can be felt, and possibly only placenta reached, by passing the introduced finger toward one or the other side. It should be remembered that complete is much less frequent than lateral placenta prævia, and that in the latter the bleeding may not occur until labor begins.

Prognosis.—The prognosis is graver the earlier hemorrhage occurs and the more completely the placenta covers the os. Not only is there danger from bleeding before birth, but also afterward, for the relaxed lower segment does not completely close the vessels opened by detachment of the placenta. There is danger, also, especially in the so-called *accouchement forcé*, of fatal tearing of the cervix and of the lower uterine segment. Finally, the examinations and manipulations and the means used for the arrest of bleeding may lead to infection, so that, according to Kaltenbach, almost as many women die from sepsis and pyemia as from bleeding.

* Nauche claimed that by his metroscope pulsation in placental vessels could be recognized; but the claim was not verified, and the metroscope is now almost unknown.

Maygrier[48] narrates four cases of fatal syncope in patients with placenta prævia, showing that severe hemorrhage from this anomaly can cause such grave anemia that death may come suddenly after the arrest of all bleeding. Müller gives the maternal mortality as 23 per cent. and the fetal as 64 per cent. King's[49] statistics show a maternal mortality of 22.5 per cent. and a fetal mortality of 57.2 per cent. Winckel believes the mortality from placenta prævia should not exceed 5 to 10 per cent. Such a low mortality as 5 per cent. may be secured in hospital but hardly in private practice. According to Lomer, 60 per cent. of the children die during labor; Barnes states that by his method he has had 33 per cent. of living children born; and Winckel says that the mortality of children is seldom less than 50 per cent., and in some statistics is as high as from 70 to 75 per cent. If spontaneous labor occurs, the mortality of children, according to Müller's statistics, is only 50 per cent. The chances of the child surviving in placenta prævia appear so small that some writers seem to take the ground that its life is not to be considered in determining the treatment. But this is wrong, and we fully endorse the words of Dr. Barnes:[50] "However, in admitting frankly that it is our first duty to save the mother, I insist upon the correlative law which does not permit us to sacrifice the child to this end without conclusive proof that it is only at this price the mother can be saved."

Treatment.—There is no single method of treatment in placenta prævia applicable in all cases and at all times; therefore the obstetrician will act most wisely who chooses means corresponding with the special features of the case in hand and with the emergencies that arise.

If the bleeding occurs in pregnancy, is not great, and uterine contractions are absent, rest in bed only may be advisable. Should the hemorrhage be severe, Winckel directs vaginal injections of hot water or of vinegar and hot water, and also the colpeurynter. Martin advises that there be provided aseptic balls of cotton-wool, with which the midwife or nurse should tampon the vagina after the use of an antiseptic injection, so that the hemorrhage may be arrested at once while awaiting the arrival of the physician. The induction of premature labor in placenta prævia was advocated in England several years ago, chiefly by Greenhalgh, and in America mainly by Thomas. For some years past Murphy of Sunderland has followed this practice, and his results, so far as saving mothers is concerned, have been remarkably good. His method of treatment will be referred to again. We believe that in many cases Spiegelberg is correct in saying that the hemorrhage in the latter months is caused by commencing labor. The obstetrician will simply then accept Nature's plan and facilitate her action.

Should there be hemorrhage in labor, the os dilatable, and lateral placenta prævia with presentation of the head, let the membranes be ruptured, for, as Martin states, we may expect the inferior pole of the fetus to occupy entirely the lower portion of the uterus, and the presenting part to press upon the bleeding placental site and to excite uterine contractions. In most cases of this variety of prævial placenta no other interference will be required; if,

however, delay demands active interference, the forceps may be used. If the pelvis presents, the same plan of treatment is to be pursued, except that it is advisable to bring down a foot. In transverse presentation, of course, podalic version is indicated. But now suppose the physician is called to a case of placenta prævia in which the bleeding is severe, whether in pregnancy or in labor, and the os barely admits the finger and is rigid, or the cervical canal is not readily penetrable: most obstetric authorities agree in advising a tampon. Winckel uses for this purpose iodoform cotton, and others advise iodoform gauze (Fig. 98); creolin gauze would be just as useful and has no unpleasant odor. Auvard* recommends cotton or charpie, 1500 grams being needed: this material is made into balls the size of a walnut, which are placed in a 2 per cent. solution of carbolic acid, or in a 4 per cent. solution of boric acid, or in a 1: 1000 solution of corrosive sublimate, until thoroughly saturated. Before being used the fluid absorbed by these balls is squeezed out, and to facilitate their introduction and to secure thorough packing an antiseptic cerate is used. Fifty or sixty of the balls will be needed.

A Sims speculum greatly facilitates the introduction of a tampon. Winckel

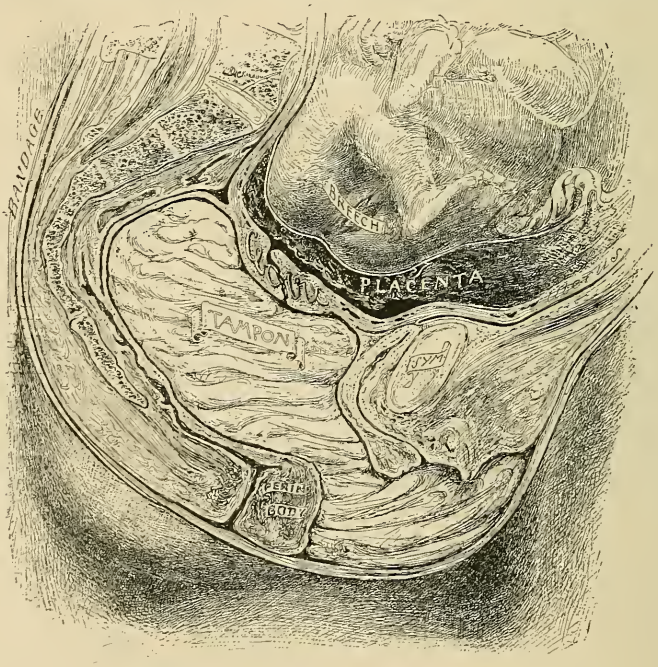


FIG. 98.—Placenta prævia: vagina tamponed with gauze.

states that a tampon may be applied so thoroughly that not a drop of blood can escape from the vulva. He leaves the tampon in place in central and lateral placenta prævia until the os is completely dilated, so that either the presenting part of the child can enter the os, thus itself making a tampon, or, by the introduction of the hand, the hips are brought down, thus accomplish-

* Pajot has said that a hatful of the material will be required.

ing the same end. Barnes* would not leave a tampon in the vagina longer than an hour, but Bailly lets it remain for twenty-four hours, and Tarnier for twelve hours; the last practice is probably the best. Some—Pajot, for instance—let the tampon be expelled with the child. [The high fetal and maternal mortality of central placenta prævia, especially when the os is closed and the hemorrhage profuse in a primigravida, has brought to widespread discussion in recent years the availability of Cesarean section, as offering better results for mother and child than any other plan of treatment. Zinke† discussed this question, collecting 8 cases for which Cesarean section was performed. He excludes 2 cases, moribund when operated upon, and concludes that "at the present time, with only 6 cases deserving record, we have a maternal mortality of 17 per cent. and a fetal mortality of *nil* in the treatment of placenta prævia by the aid of the Cesarean and Porro operations."

A careful consideration of the cases submitted to Cesarean section, of the arguments advanced in favor of and opposed to such radical treatment, and the writer's experience in treating placenta prævia convinces him that Cesarean section is not to be seriously considered except under the following conditions: When the os is undilated, the hemorrhage uncontrolled by firm tamponade, the child at term and living, the patient uninfected and not moribund from loss of blood, and her environment such as to favor a rigidly aseptic operation. The conditions named will rarely be encountered. The gravity of the case often first declares itself by profuse hemorrhage. The patient then is an unfavorable surgical subject. She frequently will have been subjected to manipulation that has infected her, and the great probability of postpartum hemorrhage from the lower uterine segment will render the Sänger operation of doubtful utility in most cases. Valuable time will be lost in the necessary preparation for Cesarean section. The child may not be viable. In 50 cases of complete placenta prævia in Schauta's‡ clinic only 18 had reached full term, and the life of a premature infant under such circumstances is in the greatest jeopardy by any means of delivery. The maternal mortality of placenta prævia, since the era of clean obstetrics, is not greater than from 5 to 10 per cent.

In Schauta's clinic § 234 cases were treated in the last ten years, with a mortality of 6.8 per cent. for mothers and 54 per cent. for the children. Of 50 cases of central placenta prævia, the maternal mortality was 18 per cent., and of the children, 70 per cent. died.

Zinke‖ has collected 8 cases of Cesarean section done for central placenta

* The following passage is taken, not from his paper at the Brussels Congress, but from his *Obstetric Medicine and Surgery*: "Vaginal plugs are treacherous aids, requiring the most vigorous watching. The plug, introduced with so much pain to the patient, soon becomes compressed, blood runs past it or accumulates above or around it, and the tide of life ebbs away unsuspected. Never leave the patient trusting to vaginal plugs. Feel her pulse frequently, watch her face closely, examine to see if any blood or tinged serum is oozing externally. Remove the plug in an hour at furthest, and feel if the os is dilating."

† *Am. Gynecological and Obstetrical Journal*, October, 1901.

‡ *Interstate Med. Jour.*, April, 1902. § *Loc. cit.* ‖ *Loc. cit.*

prævia: 3 mothers (37.5 per cent.) and 2 children (25 per cent.) died. He would exclude 2 cases as unfavorable for operation, and thus reduce the mortality to 17 per cent. for the mothers and *nil* for the children.

The future will probably reveal the fact that the operation can never be generally adopted, that it offers in some cases better chances for saving the child by adding risk to the mother, and that it shall be "elective" only by the judgment of one skilled both in obstetrics and abdominal surgery.—Ed.]

The practice which has in recent years been received with most favor by the profession is, when the os can be entered by two fingers, the performance of bimanual version according to the method of Braxton Hicks, and bringing down a foot, so that tamponing is effected first by the leg, then by the thigh, and finally by the hips, of the child (Fig. 99). The labor is not hastened unless there is some special demand for its prompt ending, but gradual dilatation of the os is made. In case it be impossible to reach the membranes in complete placenta prævia, the placenta is perforated.

It appears that Martin, at a meeting of the Naturforscher at Hamburg (1876), and then in his *Guide to Obstetric Operations* (1877),[51] made a definite proposal for the successful treatment of the majority of cases of placenta prævia, which treatment has later been established by Behm, Hofmeier, Schülein, and others. The chief point in this treatment is bringing down the hips, so that by their pressure bleeding from the loosened placenta may be stopped and at the same time uterine action may be developed.

If hemorrhage continues after the birth of the child, manual removal of the placenta is performed. If hemorrhage still continues, the injection of hot water, compression of the uterus, the administration of ergot, compression of the aorta, autotransfusion, injection into the rectum at frequent intervals of normal salt-solution, such as will be mentioned in the treatment of post-partum hemorrhage, and also the hypodermatic injection of the salt-solution, are among the important means to be employed. A bleeding tear in the cervix may be stitched. Broths and milk may be given as freely as they can be taken, and there may be required alcoholic stimulants as well as the hypodermatic use of ether. Winckel commends the method of Breisky and of Klotz, of compressing the bleeding lower part of the uterus with one hand in the vagina and the other upon the abdomen, the compression being continued for half or three-quarters of an hour.

Dr. Barnes, in the paper already referred to, gives the following résumé of his method of treating placenta prævia:

"1. Rupture the membranes; this disposes the uterus to contract.

"2. Apply a firm bandage over the abdomen.

"3. A tampon may be introduced to gain time, but it is not necessary to do it. Watch, observe with vigilance.

"4. Detach all the placenta adhering within the inferior zone, and always watch. If there is no hemorrhage, wait a little. The uterus may perhaps do what is necessary. If this fails, dilate the cervix with the hydrostatic dilator.

Wait and watch. If the natural forces fail, employ the forceps which gives the best chance to the child, or as a last resort perform version.

"5. Avoid as far as possible everything which disposes to septicemia. There

FIG. 99.—One leg has been drawn down, so that the os is tamponed and the placenta directly compressed by the hips of the child (Müller).

are four factors which dispose to it: (*a*) The bruising and other lesions of the uterus; (*b*) the retention in the uterus of fragments of placenta or membranes or of clots; (*c*) deficient contraction of the uterus; (*d*) activity of absorption, increased by loss of blood. All these causes are reduced to a minimum in

following the preceding therapeutic principles. But there are still other special precautions. After the placenta is expelled examine it carefully to see if it is entire. If the uterus does not contract well and if blood flows, inject hot water, temperature of 45° C., adding a little iodin or carbolic acid, or else, if the hemorrhage persists, the perchlorid of iron. It would be more useful to repeat the uterine injections daily for a week. The activity of absorption indicates the use of a generous diet."

In connection with the method of Dr. Barnes, as above given, reference may be made to the plan pursued by another celebrated British obstetrician (Radford) in 1826: "A multipara in the seventh month of pregnancy had severe hemorrhage, for which a tampon was used; a month after this there was slight flooding, which yielded to rest, etc.; labor came on two weeks subsequently, and there was considerable hemorrhage. Upon examination the os was the size of a crown. As the pains were now frequent and strong and the discharge continued, after placing a regulating bandage—one end being fastened to the bed and the other held by the nurse and tightened as required—I passed my hand, and first detached a considerable portion of the placenta, and then ruptured the membranes. The bandage was drawn so as equally and firmly to support and compress the uterus as its size lessened by contraction and the escape of the waters." The result was favorable for both mother and child. Radford gave the reason for detaching the placenta thus: "I detached the placenta as freely as I thought necessary for the passage of the child, as it is better systematically to do this rather than run the risk of the tearing of the structure of this organ by the force it must sustain at each pain, when the os uteri has to be dilated by the head of the child after the membranes have been ruptured."

The point of interest in comparing these methods is that each obstetrician detached partially the placenta, though for a different reason.

Murphy, who has for years advocated and practised the induction of labor in placenta prævia, recently made the following statement:[52] "In every case where placenta prævia is evident after the seventh month, or even before then, I bring on premature labor and remain with the patient until she is delivered, treating her on the lines laid down by Barnes." Murphy has now had 61 cases with only two deaths, and one of the two was moribund when first seen. Instead of the fiddle-bag dilators of Barnes some have used, for the induction of labor and at the same time to prevent hemorrhage, the *ballon* of Champetier de Ribes. Harris[53] recently recorded very successful results from dilating the os uteri with his fingers in placenta prævia. Parks Ritchie[54] narrates two cases of placenta prævia in which the mothers and children were saved by *accouchement forcé*.*

* When the placenta was in advance of the child, or *filius ante patrem*, as Paré said it was called, *accouchement forcé* was held by the old accoucheurs as the essential method of delivery. Guillemeau (1649), according to Dunal, was the true inventor, or rather promoter, of this obstetric operation; but in recent years many of the cases reported as *accouchement forcé* are instances simply of rapid delivery, no violence being employed, and the term has thus been changed in its signification.

Accidental Hemorrhage.—The hemorrhage resulting from premature separation of the placenta occupying its normal site is called "accidental" (Fig. 100). This detachment may occur in pregnancy or in labor, but is much more frequent in the former; it may be complete or partial; the latter happens much oftener than the former. Premature detachment of the placenta is not a common event, for Goodell in 1870 collected only 105 cases of the accident.

Etiology.—Among the causes of accidental hemorrhage some of the acute infectious diseases, such as variola and scarlatina, have been asserted; but more obvious and more generally accepted are traumatisms, as from falls, blows, concussion, jolting, etc; so, too, direct pressure upon the abdomen, violent sneezing, coughing, straining, or vomiting. But in how many hundreds of cases many of these may occur without the placenta being separated from the uterine wall! Brevity of the cord, great distention of the uterus, as from plural pregnancy or excess of amnial liquor, and simply the normal contractions of the uterus in pregnancy, have been included among the causes. Kaltenbach states that if the placenta is detached by the contractions, it must be

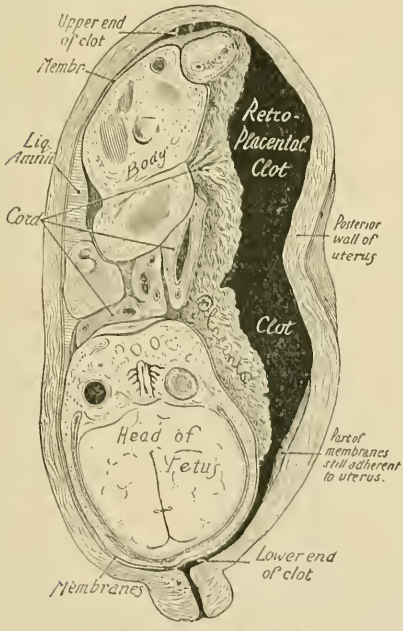


FIG. 100.—Accidental hemorrhage. Blood collected between placenta and part of membranes and the uterine wall (Pinard and Varnier).

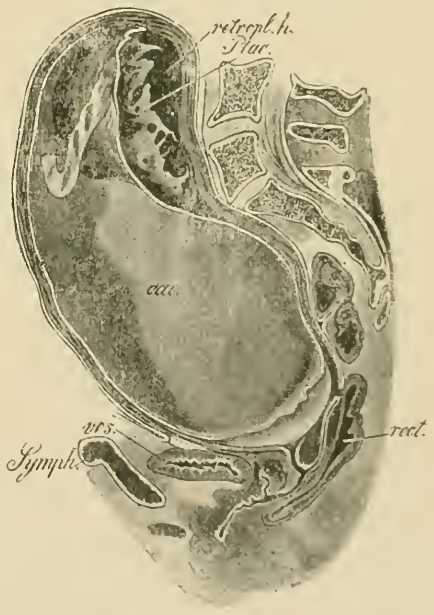


FIG. 101.—Premature detachment of the placenta occupying its normal site. Frozen section of an undelivered woman dead of eclampsia (after Dr. Winter). A blood mass under the placenta.

assumed that changes in the inner portion of the serotina have made the tissue friable and readily torn. The importance of nephritis as a cause for premature separation of the placenta has been established by Winter; but, as Veit has said,[55] we cannot explain the origin of the bleeding in renal maladies without the medium of endometritis; he maintains that the chief cause of premature detachment is disease of the deciduæ. That the placenta in these cases is

diseased has been proved by several observers; infarcts have been found, also inflammation, and, in the case reported by Coe,[56] fatty degeneration.

Of 81 cases of accidental hemorrhage recorded by Johnston and Sinclair (*Practical Midwifery*), no cause could be found for its occurrence in forty-six. Graefe[57] has recently published a case of premature placental detachment in which shortness of the cord was the cause of the accident; the length was only 31 centimeters. The patient was a primigravida, and the first bleeding occurred about the time of the descent of the head into the pelvic cavity—that is, about four or five weeks before the normal end of pregnancy, but in this case ten days before labor. It was believed that partial detachment resulted from the strain upon the cord in the descent, the primary separation being in the lobe to which the cord was attached; after birth the navel was immediately in front of the vulva. Underhill[58] has published a case in which severe pressure upon the abdomen was the immediate cause of the detachment: A large, powerful woman, quite heavy, in the ninth month of pregnancy, was engaged hanging clothes out of a window to dry, the greater part of her weight being supported by the window-sill, upon which her abdomen pressed. Violent uterine hemorrhage at once occurred, and the loss of blood was so great that she fainted. The writer had a case in which partial separation of the placenta was caused by a fall, the woman being at the end of the seventh month; nearly a quart of blood was almost immediately discharged, and then the flow ceased. This patient went to term, being then delivered of a living, well-developed child.

Symptoms.—The bleeding is internal (that is, latent) or external. The illustration (Fig. 101), from Winter, shows a partially detached placenta with a mass of blood effused between the placenta and the uterine wall and also penetrating between the membranes and the uterus. In some instances the central portion of the placenta is first detached, and then the adjacent part, until the entire organ is separated except at the margin, which remains firm; there is thus formed a large cup-shaped cavity filled with blood. Dr. Coe gives the following as the signs of latent accidental hemorrhage: Irregularity and feebleness of uterine "pains," the fundus only contracting; the uterus is excessively sensitive; the sounds of the fetal heart are irregular and feeble; after a time increase in the size of the uterus, and the patient complains of its excessive distention; palpation of the fetus is difficult or impossible, and in some cases there is a notable prominence at that part of the uterus in which pain has been felt; finally, there are the constitutional manifestations of great loss of blood.*

Graefe, in considering the differential diagnosis of this accident, refers to the possibility of confounding the condition with rupture of the uterus, or with hemorrhage into the sac of the ovum or into the abdominal cavity in ectopic pregnancy.

* Fritsch in the diagnosis states that the bag of waters remains tense and resistant during the intervals of uterine contractions, and that it is impossible by touch to reach the placenta (*Klinik der Geburtshülflichen Operationen*).

The cases in which there is no external bleeding are rare. Usually after a longer or shorter time blood escapes externally, and then the diagnosis cannot be doubtful.

The accompanying illustrations (Fig. 102, A, B) show the blood escaping externally in accidental hemorrhage.

Prognosis.—The prognosis in accidental hemorrhage is bad for the mother, or at least very grave, and still worse for the child. Goodell's statistics include 106 cases, and the maternal mortality was fifty-four, while of 107 children only six lived; nineteen mothers were saved out of 32 recorded by Brunton. Galabin in the statistics of Guy's Hospital found 31 cases of accidental hemorrhage, twenty-one of them being severe; five of the mothers and 66 per cent. of the children perished. Johnston and Sinclair in 81 cases had only four deaths of mothers; and in Graefe's 14 cases only two mothers died.

As Schultze has pointed out, the death of the child in premature detachment of the placenta is to be attributed not to loss of blood, but to the failure in the elimination of carbonic acid. The prognosis is more favorable in external than in internal bleeding, and more favorable, too, if the condition of the os uteri permits prompt delivery.

Fig. 102.—Showing separation of the placenta with external bleeding.

Treatment.—If external hemorrhage should occur during pregnancy, and if the quantity of blood discharged should not be great, the obstetrician will be content with enjoining the recumbent posture, cold drinks, the body lightly covered, and giving an opiate; in short, he will pursue a course similar to that required in threatened abortion. Even if there has been a copious discharge of blood, but bleeding has ceased, his chief efforts will be to relieve the patient from her prostration, no direct interference with the uterus being indicated. Possibly, as in the case under the care of the writer that has been previously mentioned, the pregnancy will not be interrupted and a living

child will be born at term. Nevertheless, such a patient must be carefully watched, and the practitioner be prepared to act promptly should serious bleeding return; in brief, his state will be that of armed expectation.

Should there be continuous and considerable flow in pregnancy or in labor, and the os not be in a condition to admit immediate or speedy delivery, Spiegelberg regards the tampon as the best treatment. It should, however, be borne in mind that thereby an open may be converted into a concealed hemorrhage; and, though the pressure of a tampon in the vagina hastens dilatation of the os and evokes uterine contractions, these results are not constant. The internal bleeding may be very great, for, as William Hunter, in referring to the capacity of the pregnant uterus, said, "We are apt to consider the uterus, when containing the fetus and membranes, as being tight and distended, so as to preserve its shape when taken out of the body; sometimes it may be so, but in the state it generally is at the ninth month it will hold a pint, a quart, or now and then two quarts, or even more. It is in rather a loose state, not quite tight, and only about three parts full."

The tampon will be employed in only exceptional cases and but temporarily. Spiegelberg's injunction must be remembered: "The onset of internal hemorrhage must be looked for, and be prevented by carefully supervising the body of the uterus with the hand." It may be well to add that after the rupture of the membranes the tampon is positively forbidden.

If the labor can be ended promptly, rupture of the membranes is indicated, for discharge of the amnial liquor is generally followed by stronger pains and arrest of the bleeding. This rupture is usually delayed until the os is half dilated, and then, should the hemorrhage continue, artificial delivery may be effected in a comparatively short time. Coe advises stimulants by the mouth, by the rectum, and hypodermatically, manual dilatation of the os followed by rupture of the membranes, and delivery by podalic version; if delay occurs from insufficient dilatation for the extraction of the head, craniotomy is done; ergot is also used. Goodell in his classic monograph [59] advised early rupture of the membranes, immediately followed by the application of a very tight binder and compresses to the abdomen, the free administration of ergot, and prompt delivery by the forceps or by version.

The Cesarean section, which has recently been recommended, is of questionable propriety, even in grave cases of accidental hemorrhage. Of course the usual means for securing contraction of the uterus when the labor is ended will be employed. So, too, those remedies that will compensate the loss of blood and hasten its restoration are indicated.

Hemorrhage after the Birth of the Child.—Severe bleeding after the child is born may have different sources. It may be caused by tears of the vagina, of the external sexual organs, or of the cervix; it may be a result of rupture or inversion of the uterus. But the present discussion includes only hemorrhage from the uterus occurring independently of lesions or displacement of that organ.

Great loss of blood may occur before or after the delivery of the placenta,

but in the former case the placenta must be partially or completely detached, for while it is completely adherent to the uterine wall it is plain there can be no hemorrhage. Grave hemorrhage during or after the third stage of labor is rare, and many a careful and intelligent obstetrician will pass his professional life without witnessing a case, at least in his own practice. Herman[60] says that the statistics of Guy's Hospital furnish but one case of dangerous post-partum hemorrhage in 2040 labors; of St. Thomas's Hospital, one in 2172; in Prussia, according to Hegar, one in 3131. Herman further states, and the profession will agree in the statement, that when so large a number of cases have recently been reported in which the iodoform-gauze tampon of the uterus was claimed to have arrested bleeding, the presumption is that many of these were cases in which the hemorrhage was slight. It might be added that in so large a number of cases some were proofs of careless obstetrics, for, as Spiegelberg has said, "I certainly do not exaggerate when I say that severe post-partum hemorrhage is almost without exception the fault of the attendant."

Etiology.—Atony of the uterus is the most frequent cause of hemorrhage after the child's being delivered; this hemorrhage, indeed, is frequently called "atonic bleeding." The causes of this failure of the uterine muscle to contract properly, closing the mouths of bleeding vessels, are many. The condition has been observed after a brief as well as after a long labor; it may follow a case of great distention of the uterus, as from plural pregnancy or from amnial dropsy; prolonged and profound anesthesia predisposes to it. The bleeding may be in consequence of albuminuria or of hemophilia, in still other cases from deficient muscular development of the uterus. Veit[61] refers, under atony of the uterus, to paralysis of that portion of the uterus to which the placenta has been attached—a condition which has been described by Engel, Rokitansky, Burchardt, Kiwisch, Chiari, and others. In this local uterine atony there is found upon abdominal examination of the uterus a depression, while internally, corresponding with the external depression, is a projecting mass.

Fritsch[62] observed a case of local atony in which he found on section a complete varicose degeneration of a part of the uterus; the paralytic portion was composed almost entirely of wide veins. The same author mentions a very dangerous form of uterine atony the consequence of infection occurring early in labor, stating that it is not wonderful, when we observe that paralysis of the infected muscular coat of the bowels leads to meteorism, that the contractile activity of the uterus should fail from a similar cause.

Penrose,[63] in his paper upon the treatment of post-partum hemorrhage, remarks: "A cause sometimes of dreadful post-partum hemorrhage is the partial morbid adhesion of the placenta to the uterus; here there is often the reverse of uterine inertia; the uterus may be in a condition of firm contraction, but the adherent placental mass, occupying no little space in the cavity of the organ, prevents and renders impossible that degree of shrinkage in size indispensable to the complete obliteration of the uterine blood-vessels, and hemorrhage is the inevitable result. To this class of causes might be added

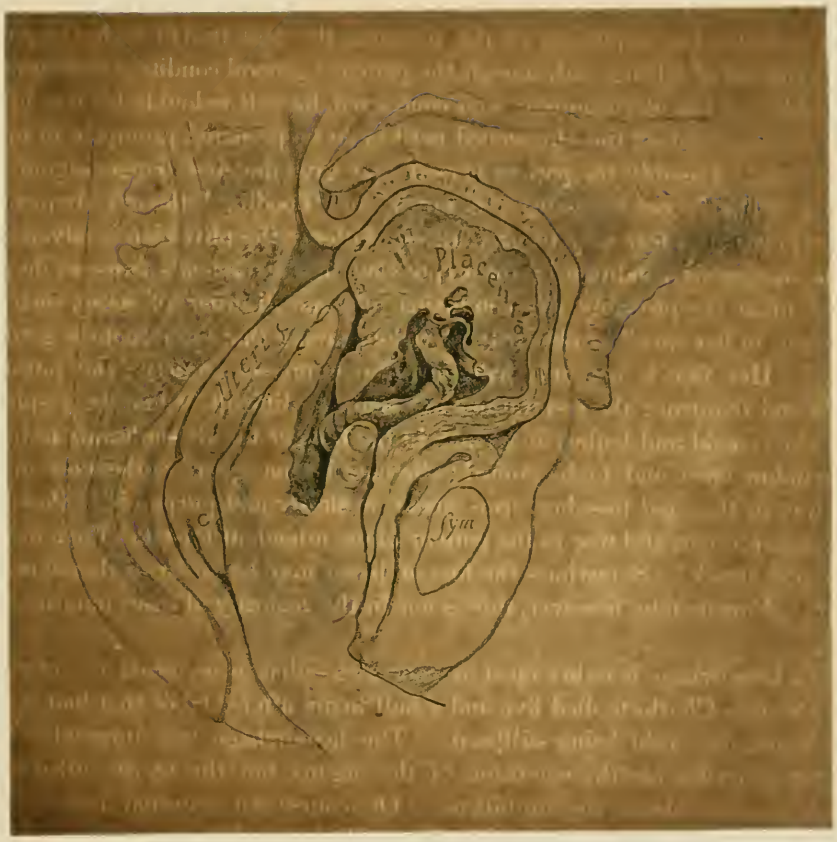
those cases where the hemorrhage is caused by the presence of fibroids in the wall of the uterus or of a polypus in the cavity."

Placenta prævia may cause post-partum hemorrhage, for the lower segment of the uterus has not the contractile power which belongs to that portion of the uterus in which the placenta has its normal site, hence the closure of torn blood-vessels is not so prompt and complete, if the placenta be attached, in the former as in the latter. In concluding this topic we believe the prevention of post-partum hemorrhage is in most cases secured by proper management of the third stage of labor.

Symptoms.—Frequency of the pulse is often a herald of bleeding. Whether before or after the expulsion of the placenta, the obstetrician finds the pulse rising instead of falling, and, though the patient's general condition may appear favorable and the uterus appear well contracted, he will redouble his watchfulness, seeking to avert the threatened peril or to be prepared promptly to meet its coming. Possibly the patient herself may give the first danger-signal by asking if she is not "wasting too much" or "flooding," though frequently this expression of fear may be groundless. Oftener the physician is advertised of the dangerous condition by the expression of the patient's face—so deep a pallor upon it; probably she complains of some disorder of sense, such as "ringing in her ears" or obscurity of vision, saying that "the room is getting dark." Her face is not only pale, but also expresses anxiety; the pulse is feeble and frequent; the respirations are shallow, difficult, it may be gasping; the skin is cold and bathed in sweat; in the hunger for air she wants to have the window open and to be fanned; she may in her great restlessness move this way or that and toss her arms about restlessly and purposely. Possibly convulsions occur, and woe to the patient whose attendant mistakes them for an eclamptic attack! Sometimes the loss of blood may be so great that syncope occurs. Fortunately, however, this is not in the majority of cases immediately fatal.

The hemorrhage is either open or concealed—that is, external or internal. The Princess Charlotte died five and a half hours after a labor that had lasted fifty hours, the child being stillborn. The hemorrhage was internal. The autopsy proved a healthy condition of the organs, but the uterus, filled with blood, reached above the umbilicus. Of course an external hemorrhage reveals itself, and an internal bleeding will be readily recognized by the hand of the obstetrician placed upon the patient's abdomen, for thereby he finds the uterus greatly enlarged, relaxed, and probably its boundaries not easily defined. It ought to be noted that a bladder distended with urine may simulate an enlarged uterus, and, even if it does not, causes great ascension of that organ. To mention the possibility of the error is to avert it.

Post-partum hemorrhage has been divided into primary and secondary. Unfortunately, authors differ as to the boundary-line between the two, some including under the latter a bleeding that begins a few hours after labor, while others advance the limit to twenty-four hours or even some days. In the present discussion all hemorrhages occurring within the first twenty-



Method of manipulation for artificial separation of the adherent placenta.

four hours will be regarded as primary, and these only will now be considered, secondary hemorrhage being subsequently discussed.

Prognosis.—The prognosis is graver the earlier the bleeding occurs, and, of course, graver, too, the greater the loss of blood. The character of the discharge is also of prognostic significance, for if the blood is thin, serum-like, and without clots, the fluid itself is at fault and the danger of death is imminent. Severe pain in the back is regarded as testifying to uterine activity, and therefore as ground for encouragement. Hippocrates made hiccough and spasms ominous in hemorrhage, and Lachapelle counted dilatation of the pupils a grave prognostic sign.

Treatment.—It is of immediate importance to lessen the flow of blood and to excite uterine contraction. One step in the accomplishment of the first is to lower the patient's head, taking away pillow and bolster, and to raise the foot of the bed. Let the obstetrician by his words and acts prevent panic on the part of those present and inspire confidence and hope. Instant compression of the uterus is made, and the effort is exerted to promote its contraction by this pressure and by friction. The introduction of one hand into the uterus with the other upon the patient's abdomen may be necessary to remove the placenta or a part of it or coagula or membranes (Pl. 41). It is important before this manipulation that the genital canal be disinfected, which may be done by carbolic acid, creolin, or lysol, washing it out with hot water containing one of these antiseptics; furthermore, the hot water has this advantage, it stimulates the uterus to contract. Disinfection of the operator's hand and forearm is still more important, and this may be accomplished, Fehling states,[64] in five minutes by Fürbringer's method. This precaution is especially necessary if a partially free placenta is to be detached, for, as Stumpf has said, the manual detachment of the placenta is the most dangerous obstetric operation. [The value of rubber gloves can never be greater in obstetric practice than in removing a partially detached placenta.—Ed.] The introduced hand, by its contact with the uterine walls, may evoke the action of the organ, and the removal of the uterine contents permits retraction. In the removal of the separated placenta it is usually better that both hand and placenta be expelled rather than withdrawn. Meantime ergot may be used hypodermatically with the hope of stimulating the uterus to contract. If the patient is very much exhausted by hemorrhage, sulphuric ether, as originally advised by Hecker—20 drops, for example—should be injected deeply in the thigh, three such injections being made.

Among the older means of evoking uterine contraction are striking the exposed abdomen with a wet towel, and the introduction of a lump of ice into the uterus. The obstetrician now generally prefers to the use of cold the injecting of hot water into the uterus. Penrose has for many years warmly advocated vinegar as an invaluable help in post-partum hemorrhage. He has given the following as his method of using it:[65] "I pour a few tablespoonfuls into a vessel, and dip into it some clean rag or a clean pocket-handkerchief. I then carry the saturated rag with my hand into the cavity of the uterus and

squeeze it; the effect of the vinegar flowing over the sides of the uterus and through the vagina is magical. The relaxed and flabby uterine muscle instantly responds. The organ at once assumes what I will term its gizzard-like feel, shrinking down and compressing the operating hand, and in the vast majority of cases all hemorrhage ceases instantly; should one application of vinegar fail to secure sufficient contraction, the hand can be withdrawn, and a second or even a third application can be made, until the uterus shall contract sufficiently to stop the flow of blood." Contamin in his monograph[66] states that "irritant substances placed in the uterine cavity act in the same manner as ice, and are more readily employed. In the time of Hippocrates a pomegranate from which the bark had been removed was introduced into the uterine cavity. In our days a lemon has been employed (Evrat, Moreau), or a sponge saturated with vinegar (Bigest, Desgrange). All these agents readily excite uterine contractions when they are immediately in contact with the walls of the womb."

Uterine injections are as old as the time of Hippocrates, but probably Pasta in 1750 first advised the introduction of a solution of "calcined vitriol" for the arrest of hemorrhage. Dr. Robert Barnes in 1857 strongly advocated injection of a solution of perchlorid of iron. The formula recommended by him is $1\frac{1}{2}$ ounces of the liquor ferri perchloridi (British Pharmacopœia) and $8\frac{1}{2}$ ounces of water. The following are his directions for the use of this solution:[67] (1) "Be sure that the uterus is empty of placenta, blood, and clots; (2) compress the body of the uterus during the injection; (3) have two basins at hand, one containing hot water, the other the ferric solution; pump water well through the syringe (a good Higginson's will do), so as to expel air, then pass the uterine tube into the uterus, and inject first hot water, so as to wash out the cavity and give a last opportunity for evoking diastaltic contraction; then shift the receiving end of the syringe into the ferric solution, and slowly, gently inject about seven or eight ounces, carefully keeping up steady pressure on the uterus throughout and afterward." Spiegelberg[68] objects to the strength of the solution advised by Barnes, and suggests that half an ounce of the liquor ferri perchloridi be added to a pint of water, stating that "a high degree of concentration would undoubtedly corrode the internal surface of the uterus, and might thus lead to extensive and deep thrombosis of the uterine wall and to its sequelæ; it might also produce gangrenous endometritis and secondary infection, or cause the thrombi to be broken down and carried away by the veins." Some have advised, instead of injecting the uterus with an iron-salt solution, swabbing the bleeding surface with a sponge that has been dipped in the solution. In recent years, however, the employment of the Barnes method has had few advocates, not only because some fatal cases have followed it, but also because of the prompt hemostasis usually resulting from injections of hot water. [Since the days of antisepsis and asepsis such means of provoking uterine contraction have been discarded. Sterile water heated to 110°–120° F. and the intra-uterine tampon of sterile gauze are to be preferred.—Ed.]

Dr. Atthill,[69] in December, 1877, in reporting to the Dublin Obstetrical Society some cases of post-partum hemorrhage in which he successfully used hot-water injections, stated that he was led to their employment because of a private letter from Dr. Whitwell of San Francisco. Dr. Whitwell's statement was to the following effect: When house-surgeon at the New York State Women's Hospital in 1874 he saw the uterus contract firmly and instantly upon being washed out with hot water after an operation by Dr. Marion Sims upon a sarcomatous growth of the fundus uteri. The result led him to try the same treatment in post-partum hemorrhage, and he met with perfect success. He afterward succeeded in having the treatment tried in the Lying-in Hospital at Prague, and the method was so successful that it was adopted as a regular routine treatment. Windelband,[70] in January, 1875, stated that by the recommendation of an American physician living in New Foundland he had for a year employed hot-water injections, which were advised by this physician for the hemorrhage of abortion. Windelband used them not only in the hemorrhage in miscarriage, but also in that occurring in two cases of prævial placenta, in hemorrhage from uterine fibroids and other growths from the uterine walls, in bleeding after birth when the uterus was relaxed, and in profuse menstruation—in fact, in all cases of uterine hemorrhage. The water should have a temperature of 112° F., and an irrigator or a fountain syringe is preferable to the ordinary instrument. A little vaselin or cosmolin should be applied to those parts of the external sexual organs with which the fluid comes in contact as it escapes from the vagina, for without this precaution the patient will complain of severe burning. The nozzle of the syringe or irrigator should not be passed into the uterus until the stream has begun, thus guarding against the possible introduction of air; it is gradually carried as high in the uterine cavity as desired, the escaping stream making a way, as it were, and facilitating this movement.

Another method of arresting uterine hemorrhage is bimanual compression (Fig. 103). The patient lies upon her back with the lower limbs drawn up;

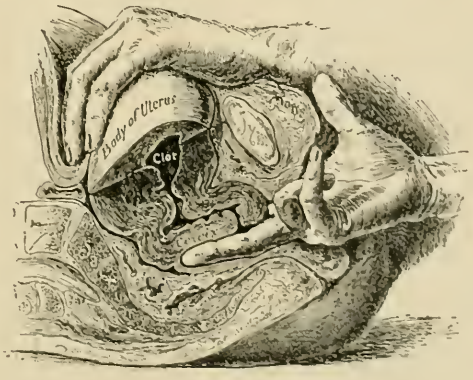


FIG. 103.—Bimanual compression of the uterus.

the obstetrician introduces one hand into the vagina, both hand and vagina having been carefully disinfected, and passes two or three fingers up to the pos-

terior vaginal vault, so that he can exert a firm pressure upon the posterior part of the cervix; the other hand, placed upon the patient's abdomen, grasps the fundus and the posterior wall of the uterus, drawing them forward, the vaginal fingers at the same time pushing the cervix in the same direction; thus the uterus is anteflexed and firmly held, so that hemorrhage for the time is impossible. The vaginal fingers may be applied to the cervix anteriorly, and the external hand to the fundus and the anterior surface of the uterus, and thus the organ may be retroflexed and arrest of bleeding be accomplished.

Fritsch[71] speaks favorably of what he calls the "rational bandaging" of the abdomen, saying: "Long prior to my injection of iron, and before Dührssen recommended the tampon, had I applied bandaging the abdomen in suitable cases, and with the best results. It is especially to be recommended in those cases in which, some time post-partum, the uterus is again distended with blood and the anemia has reached the border-line of imminent danger to life, as shown by great frequency or entire absence of the pulse. In such a case it requires considerable self-confidence to apply Dührssen's tampon, as during its application some blood is lost—at least that which saturates the tampon. In these cases I recommend and employ the following method: The uterus is pressed forward and anteverted; behind the uterus there is placed a large mass of cotton (one or two packages, amounting to 250 grams) or large pieces of muslin, or even a big book carefully and uniformly wrapped. Now a roller bandage is applied tightly, which not only compresses the abdomen, but acts upon the posterior wall of the uterus so that the organ is pushed toward the pelvic inlet. Additional turns of the bandage are made, passing above the fundus, and the uterus is fixed in its anterior position. The uterus is thus compressed in front and behind, lying against the pubic symphysis. By the abdominal compress pressure is also made upon the aorta. The blood is pressed, as it were, out of the abdomen and kept in the upper part of the body. This method, old as it is, still calls for occasional use, for it ensures prompt safety against bleeding, rapid recovery of consciousness, and an improved condition of the pulse. After such severe hemorrhage patients are not very sensitive. I have often let the bandage or compress remain twenty-four hours or longer without its removal being requested. At all events, we can in this way arrest the bleeding much more quickly than by the tampon, and at the same time we have the advantage of compression of the aorta. *I would especially advise this method of compression for those cases to which we are called in the final stages—the severest degree of hemorrhage. If seeing a case in the beginning, such great anemia may be averted by the prophylaxis of Dührssen's tampon.*"

Compression of the abdominal aorta has been successfully employed in post-partum bleeding. One of the recent arguments in its behalf is that it prevents cerebral anemia. Kaltenbach,[72] while admitting the usefulness of this compression, regards it as doubtful whether the favorable action is to be attributed to a lessened blood-supply or to a mechanical irritation of the uterine plexus. The method usually pursued is as follows: Supposing the obstetrician to be upon the patient's right side, the abdominal wall is depressed with

his left hand until the pulsation of the aorta is felt just above the uterus, and then slight pressure is made upon the vessel with three fingers, arresting the flow. An assistant is needed, for the fingers become too tired after twenty or thirty minutes to continue efficient pressure. Rudiger of Tubingen was probably the first to advise this treatment, and he exerted pressure on the vessel through the posterior wall of the uterus. This method was rejected, and Ulsamer's method, first advised in 1825, and previously given, is that generally employed.

The tampon is by no means a new way of treating uterine hemorrhage, but its recent recommendation by Dührssen has revived its use. The vaginal tampon is now never used except possibly in tears of the cervix, and then but exceptionally, and tamponing the uterus will therefore only be presented. Leroux of Dijon and Chevreul of Angiers had numerous successes with the tampon; but, as Baudelocque has said, the tampon which they employed was a sponge saturated with vinegar, usually introduced into the uterus, and it was the action of the vinegar upon the walls of the uterus which was beneficial, and not the barrier which they supposed the sponge offered to the escape of blood. Other means of tamponing the uterus that have been recommended are an animal bladder or a rubber sac, either being introduced empty, and after the introduction filled with air or with a liquid. Zweifel recommended as a final resort, other suitable means having failed, tamponing the uterine cavity with cotton that had been dipped in a solution of chlorid of iron. He preferred this method to injecting the uterus with the solution, for a patient of his perished after such injection, while another recovered when this tampon was applied. In recent years the preference for gauze (usually iodoform gauze is selected, though some advise that which has been made antiseptic with creolin) has been decided. In tamponing the uterus three strips of gauze about the width of three fingers, each strip nearly 10 feet long, will be provided.* The strips have been dipped in a 20 per cent. solution of iodoform, and iodoform is sprinkled upon them just before they are used. The patient lies upon her back across the bed, and two tenaculum forceps are used, one to seize the anterior, the other the posterior, lip of the uterus, and by them the organ is drawn toward the vulva. An assistant holds these forceps. A long uterine dressing-forceps grasps one end of a strip of gauze, and is used to carry this up to the fundus of the uterus; at the same time the operator has his hand upon the patient's abdomen over the uterus. One fold after another is laid upon that first introduced, and thus successive layers are disposed like the folds of a closed fan until the strips are all introduced and the cavity is completely filled. The uterus contracts, it is claimed, because of the contact of a foreign body with its walls. The tampon does not cause suffering, and it is removed at the end of twenty-four hours, and the uterus is washed out with an antiseptic solution. No matter what tampon is used, it cannot succeed if fragments of placenta are left in the uterus; they therefore must be removed before its introduction.

* Playfair has said that the puerperal uterus will hold two ball-dresses! This being true, one need not be astonished at the quantity of gauze required.

Schauta, in his paper, *Die Behandlung der Blutungen post-partum*, after referring to his own successful employment of the gauze tampon, states that failures have been reported by Dührssen himself and by Fritsch and Olshausen, and advises, if the hemorrhage continues after the tampon has been introduced, that the strips be removed and fresh tamponing made after washing out the uterus, the gauze being packed more thoroughly. The tampon will be a failure, he says, in case the bleeding results from large arterial vessels that have undergone atheromatous degeneration, or even a single such vessel at the placental site. He adds that in such cases the removal of the uterus by supravaginal amputation may be considered in a well-conducted clinic, but in private practice would not as a rule be thought of. The proposition of Kocks he regards as worthy of consideration. This suggestion is to invert the uterus, and after the organ has been brought down it is to be encircled by a piece of rubber tubing or by a firm bandage, best of a strip of iodoform gauze, so placed that the placental site shall be below it. Necessarily the bleeding will be thus immediately arrested, and at the end of six hours the bandage is removed, and, the hemorrhage not reappearing, the uterus is restored, this restoration, according to the communication of Kocks, being accomplished without difficulty.

Kaltenbach states that the introduction of a gauze tampon is very difficult in case of a flaccid uterus, and often it is incompletely done, and thus the bleeding remains internal. He further states, after referring to the dangerous embolism which may result from injecting an iron solution, that the gauze tampon is especially applicable in cases of deficient coagulability of the blood.

Herman,[73] in criticising the gauze treatment, remarks that we must judge the effect of treatment of post-partum hemorrhage rather by the fewness of the failures than by the number of apparent successes. Fritsch has recorded a case in which death occurred from atonic hemorrhage notwithstanding the tampon; and other cases, in which the cause of death was not clear, have been published. One case of fatal air-embolism, occurring while the tampon was being introduced, has been reported. To the assertion that the treatment is neither certain nor safe he adds that it is unphysiological, for the uterus cannot be completely contracted while the gauze is in it. Certainly the cases are very rare in which this treatment will be required.

Quite exceptional, too, are those cases in which a departure from the rule, long established and almost universally held, that the uterus must be emptied of clots, is justifiable. "Turn out that clot!" has been the injunction of obstetric teachers for a century or more; yet it may be that in some very rare instances the direction should be, "Do not turn out that clot." In Contamin's paper the following case is narrated: "There are, nevertheless, cases in which clots seem to oppose a barrier to the flow of blood. In one of his patients Professor Bouchacourt three times emptied the uterus of clots. After each evacuation the hemorrhage recurred and clots were again formed in the uterine cavity. The patient was exhausted and syncope was imminent. As the size of the uterus was not very great and did not seem to increase, this fact indi-

cating that the hemorrhage was suspended, the clots were left in the uterus. "The hemorrhage did not recur, and the following day the clots were spontaneously expelled. In this case the clots had the *rôle* of an obstacle to the flow of blood, and it might be asked, What would have happened if the obstetrician had determined at all hazards to empty the uterus? In exceptional cases only can this practice be followed. Nevertheless, we are justified in temporizing when the hemorrhage seems arrested, and especially if the firmness of the uterus indicates return of its contractions." To this case may be added one recorded by Dr. James F. Hibberd,[74] in which a similar practice was successfully followed. There was this difference, however: Dr. Hibberd's patient fainted twice from the loss of blood.

The means for compensating the loss of blood are transfusion, autotransfusion, subcutaneous and intravenous infusion of a sterilized solution of chlorid of sodium—the so-called "normal salt-solution"—and rectal injections of this solution. Transfusion, in which the blood from another person is introduced into the venous circulation, is now scarcely ever employed. In autotransfusion the limbs are bandaged so that the great mass of blood which they contain is forced toward vital organs, especially the heart. In this operation flannel bandages are used, those of rubber being objected to because by their great compression thromboses, and later embolism, may be produced. For hypodermatic or intravenous use, and also for injections in the rectum, the physiological or normal salt-solution is prepared by adding 6 grams of chlorid of sodium to 1 liter of water free from germs. Winckel advises 1 drop of caustic solution of sodium to be added to the mixture. The hypodermatic application is made with Munchmeyer's apparatus, which consists of a funnel, a rubber tube, three needles, and a thermometer. Under careful aseptic precautions the fluid may be injected in quantities of a liter, under the breasts, into the subcutaneous areolar tissue of the back or thighs. The danger of infection and abscess formation should always be borne in mind, and under circumstances when the strictest details of cleanliness cannot be obtained, high rectal injections should be preferred.

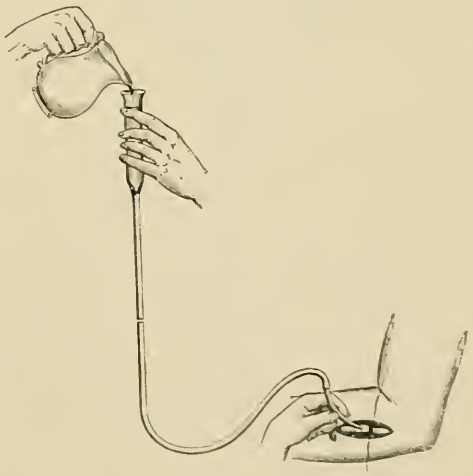


Fig. 104.—Intravenous injection.

Before describing intravenous introduction of normal salt-solution it should be mentioned that much may be accomplished to prevent the injurious consequences of loss of blood by having the patient drink the fluid as freely as she can without causing irritability of the stomach, and also by injecting as much of it in the rectum from time to time as will be tolerated.

Intravenous injection of normal salt-solution, approximately one teaspoonful of salt to a pint of water that has been boiled and has a temperature of 100° F., may be made with a glass funnel, a rubber tube, and a cannula. Horrocks,[75] from whose paper the accompanying illustration (Fig. 104) is taken, describes the operation as follows: "Make an incision about one inch long and expose the median basilic or any other vein of not less calibre. In some cases it is found useful to cause filling of the vein by tying a pocket-handkerchief or bandage round the arm. With a needle pass a silk, gut, or other ligature under the vein, cutting it so as to leave two ligatures. Draw one to the lower angle of the wound, and tie it round the vein by a double knot, cutting the ends short. With the dissecting-forceps pinch up the vein and make a small nick in it with scissors, taking care not to sever the vein completely. Introduce the cannula (silver or glass) into the vein, and tie it in by means of the upper ligature, leaving the ends long as in the Figure. The blood will flow down the cannula, and when it is full the rubber tubing, previously attached to the glass funnel and filled with the saline solution, is fixed on the end. The funnel is now raised, and as the water flows it is replaced by pouring in more of the saline solution from a jug (pitcher) held close to the rim to prevent air-bubbles being formed. As long as the funnel is kept above the level of the cannula, air-bubbles will always rise to the surface and escape. Another method of introduction, and one recommended in severe cases, is to fix the funnel and the cannula in the tubing, fill the apparatus with salt-solution till it runs out warm, and then to introduce the cannula into the vein, the funnel being held by an assistant slightly higher than the cannula, so as to keep up a gentle flow which washes away the oozing blood and ensures the absence of air. The speed at which the fluid is injected can be regulated by raising or lowering the funnel. In most cases a distance of about 3 feet is sufficient, and the flow is found to be about a pint every four minutes. When enough has been injected, remove the cannula from the vein. Cut the latter completely across, and tie the upper end with the long ends of the ligature. Sew up the wound with a continuous or interrupted fine silk or other suture, and fix a clean pad with a bandage."

Horrocks states that enough fluid should be injected to cause the pulse to be perceptible at the wrist, and that the worst cases require about six pints. Further, in the treatment of the prostrate condition Kaltenbach commends a rectal injection of red wine and the whites of two eggs with from 20 to 30 drops of tincture of opium. He also speaks favorably of an injection once or oftener, in the upper part of the thigh, of ether, tincture of musk, or camphorated oil (1 : 9).

Convalescence from the anemia resulting from severe bleeding will be best promoted by keeping the patient in a horizontal position, not even permitting her to sit up to nurse her child or to urinate. Milk, eggs, and animal broths should constitute the chief part of the diet, and alcoholic stimulants may be advisable in some cases. If the hemorrhage has been from the placental site, and especially if the flow is profuse and its bloody

character is prolonged, ergot or fluid extract of hydrastis is indicated. The first getting out of bed will be delayed several days after the usual time in patients who have suffered from post-partum bleeding. Many patients will require the early administration of tonics—quinin and iron, for example, or the elixir of phosphate of iron, quinin, and strychnin, or the compound of "beef, wine, and iron."

Lacerations and Rupture of the Uterus.—These lesions are found almost exclusively in the lower segment of the uterus; most of them consist in tears of the uterine wall that run more or less transversely (Fig. 105). They are called "complete" ruptures of the uterus when the wound penetrates all three coats of that organ, and "incomplete" when either the serous or the mucous lining of the womb remains unimpaired. Lacerations in the upper portion of the uterus are exceedingly rare.

Causes.—Sharp ridges projecting from the pelvic bones have sometimes been known to sever the walls of the uterus. These projections are most likely to be found at the promontory and along the ilio-pectineal line. If there is any mechanical disproportion between the inlet of the pelvis and the fetal

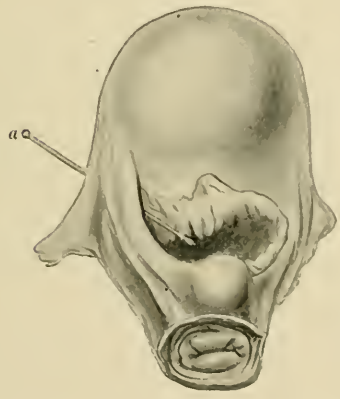


FIG. 105.—Transverse rupture of lower segment of uterus (Spiegelberg): *a*, probe inserted under the peritoneum.

FIG. 106.—Impending rupture of uterus in a shoulder presentation (much modified from Schroeder): *oe*, external os; *oi*, internal os; *cr*, contraction-ring.

head, the latter in its descent will press the lower segment of the womb against these sharp ridges with so much force that they may grind their way into the uterine tissues. Any attempt to pull the head into the pelvis with forceps will under these conditions only help to increase the amount of injury to the uterus. Incomplete rupture of the uterus, with the inner portion of the wall entire, can have originated in this manner only.

By far the greatest number of ruptures of the uterus, however, are caused in an entirely different way. They are the direct result of the uterine contractions and of over-distention of the lower segment of the uterus. This mode of origin was first pointed out in 1875 by Bandl, and since then his statements have generally been accepted as correct. During labor the upper portion only of the uterus contracts, while the entire cervix and that portion

of the body immediately above the inner os are subjected to a stretching process until they form one wide cylindrical canal. While this dilatation is going on we find that the wall of the lower segment gets thinner during each labor-pain, whereas the wall of the contracting portion of the uterus thickens and hardens. The border-line between the upper and the lower segment of the womb is marked by a ring-shaped projection of the contracting portion, the so-called "contraction-ring," which is found at a variable distance above the inner os. During the contractions the uterus has a tendency to move upward toward the diaphragm and to pull the dilated lower segment upward and away from the presenting part, the latter usually descending at the same time, this partial evacuation of the uterus preventing an undue stretching of the lower segment. If, however, a malpresentation or some other mechanical impediment prevents the fetus from descending, the stretching of the lower segment continues. The uterus, as a rule, tries to overcome the obstacle by an increase in the intensity and duration of the contractions, thereby augmenting the chances for a rupture. When there is unequal dilatation—as, for instance, in shoulder presentation, in which the greatest stretching of the lower uterus takes place on that side to which the fetal head has escaped—the rupture becomes still more imminent (Fig. 106).

The administration of ergot during labor is at times directly responsible for uterine ruptures. The writer remembers a case of a multipara with central placenta prævia in which the attending physician had plugged the vagina very effectively, and at the same time had given the patient a teaspoonful of ergotol. The tampons together with the mass of the placenta made it impossible for the presenting head to enter the pelvis; it escaped to the left iliac fossa, and when the writer saw the patient two hours later he found a transverse laceration on the left side of the uterus a little above the inner os, through which the head had entered the abdominal cavity.

From what has been said above it is evident that these ruptures must always originate in the lower segment of the uterus; which fact, however, does not preclude the possibility of the tear extending upward into and above the contraction-ring.

Symptoms.—In a minor number of cases the rupture takes place without premonitory symptoms, but usually these symptoms are well marked. The parturient woman does not rest between the uterine contractions; she complains of constant and severe pain in the lower abdomen on account of the intense stretching to which the lower segment of the uterus and the uterine ligaments are being subjected. The rupture itself always takes place during a uterine contraction, and it is usually accompanied by an intense penetrating pain. At the same moment the parturient woman feels that the child has turned or has shifted its position. The labor-pains suddenly cease; there may be a free hemorrhage; the patient's skin gets cold and clammy; the pulse becomes very frequent and thread-like in volume. Some or all of these symptoms may be missing, with the exception of a change in the character of the pulse. The abrupt cessation of the uterine activity is also very constant.

On examination the presenting part will be found to have receded, or it may have entirely disappeared. Part or all of the child has escaped through the rent, and it can clearly be outlined through the abdominal wall. If the tear does not extend through the peritoneum, then this membrane is detached so as to form a large cavity which contains the escaped fetus and a greater or lesser quantity of blood.

Frequency of the Accident.—No reliable statistics as to the frequency of rupture of the uterus can be procured, as in maternity hospitals, to which complicated cases are constantly forwarded, there will naturally be found a greater percentage of such accidents than if all labor cases from a large territory were collected for statistical purposes. In countries in which osteomalacia and rickets are common the frequency of pelvic contractions must necessarily increase the number of ruptures of the uterus. The frequency of this accident will vary also with the greater or lesser ability of the obstetrician. Bandl found one case of ruptured uterus among 1200 confinements, while Garrigues states the frequency as 1 in from 3000 to 5000; the latter statement seems to be approximately correct for the United States.

Prognosis.—Rupture of the uterus is one of the gravest complications of labor. Over 90 per cent. of the children are born dead, and of the mothers fully 60 per cent. succumb to the accident. Many women bleed to death before help can reach them; others die within the next few days from septic infection or from secondary hemorrhage. Sepsis is now recognized as the principal cause of death.

Before antiseptic times the outlook was even more gloomy, but it has greatly improved within recent years, and we may hope that in the future a still greater percentage of mothers will be saved. According to statistics published by Schultz and quoted by Winckel in his text-book, the following percentage of cures was effected in the 193 cases collected from modern literature:

Complete ruptures without treatment, 20.2 per cent.

Complete ruptures treated with drainage only, 36 per cent.

Complete ruptures treated by laparotomy, 44.7 per cent.

Treatment.—Whenever during labor the over-distention of the lower segment of the uterus can be diagnosticated, an attempt must be made to deliver at once and to accomplish this without increasing the distention of the parts. The patient should be anesthetized, as the narcosis will lessen the intensity of the uterine contractions. The mode of delivery must be chosen according to the nature of the case. In shoulder presentations version carefully executed is the proper procedure, providing the child is living. Should the child be dead, then embryotomy would be preferable, as it does not increase the tension of the uterine walls, and consequently the danger of a rupture, while version, no matter how skilfully performed, will cause some additional distention. In head presentations a gentle attempt with the forceps should be made, always taking it for granted that the child is living. Failing with the forceps, the only choice lies between Cesarean section and craniotomy of the living child. Version in these cases is out of the question, because the stretching of the

uterus in a transverse direction is very much greater when the operation is performed in head presentation than when it is resorted to in shoulder presentation, where the child lies already with its long axis more or less transversely in the uterus. Under favorable surroundings Cesarean section should always be the operation for treating this emergency, and craniotomy should be performed in those cases in which the child has ceased to live.

After the rupture has taken place a speedy delivery is also called for. If a part of the child is retained in the uterus, delivery through the natural passages should at once be attempted. Usually we are able to extract the child by the feet. The placenta is removed next, and the parts are then cleaned and examined. Hemorrhage may not be very great, as the uterus generally contracts well as soon as it is completely emptied. The patient should be allowed to rest, and she may be stimulated with hypodermatic injections of ether, brandy, and like agents. If she rallies, the further treatment must be decided upon. The question will be: Shall the abdomen be opened, the rupture be closed by sutures, and the peritoneal cavity be cleansed of the blood and meconium that have entered it, or shall the treatment be confined simply to cleansing the vagina with disinfecting irrigations and introducing a glass tube or a roll of iodoform gauze into the rent in the uterine wall to provide drainage for the infected peritoneum? When the accident has happened amid surroundings that would not be objectionable to laparotomies for other causes, there is no good reason why the patient, provided she has rallied, should not be given the full benefit of the modern advance in abdominal surgery. Laparotomy performed under these conditions cannot expose the patient to any additional danger, but it can greatly improve her chances for recovery.

When the child has entirely escaped from the uterus or when it cannot be extracted through the *vias naturales* without greatly increasing the laceration, there is no choice in the mode of treatment. The abdomen must be opened and the child be taken away after ligating the umbilical cord; the placenta is best removed by compressing the uterus, when the after-birth usually glides down into the vagina, whence it can be extracted by the hand. The tear is now repaired by suturing, care being first taken to unite the muscular coat of the uterus, and then to close the peritoneum separately with the edges folded in, so as to ensure a good and speedy union. When one is reasonably sure that infection has occurred; when the tear is so contused, tattered, or gangrenous as to forbid the hope of primary union; or when the uterus is myomatous, hysterectomy, usually total, is indicated.

Incomplete ruptures, with the peritoneum detached from the uterus, do not necessitate laparotomy. The newly formed cavity is washed out through the rent and a drainage-tube or a roll of iodoform gauze is inserted to give escape to the secretions. The same treatment is pursued in complete ruptures, as already stated, whenever laparotomy is decided against. In the latter case no attempt should be made to wash out the abdominal cavity through such a tube: the tube should serve for drainage

only. Schmit * studied carefully 19 relatively recent cases of rupture of the uterus that were treated in Schauta's clinic, and concluded that, except in cases attended by severe hemorrhage, drainage by iodoform gauze affords decidedly better results than laparotomy and suture. He believes this applies to complete, as well as incomplete, rupture, when hemorrhage is not severe. Of 7 cases of incomplete rupture treated by gauze drainage, 2 died, a mortality of 28.57 per cent. Of 10 cases of complete rupture 4 were treated by operation, with a mortality of 50 per cent.; 6 were treated by gauze drainage, with a mortality of 50 per cent.

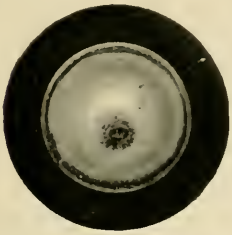


FIG. 107.—Cervix of virgin (Heitzmann).

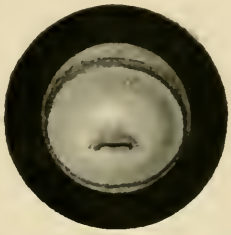


FIG. 108.—Another form of external os in the virgin (Heitzmann).

FIG. 109.—Cervix after miscarriage (Heitzmann).

Injuries to the Infravaginal Portion of the Uterus.—Physiologically there is a laceration of the vaginal portion of the cervix in all primiparæ and also in some multiparæ. This laceration, which is usually bilateral, runs in a transverse direction, so that in women who have borne children the external os is no longer a small round opening surrounded by a perfect ring of tissue,

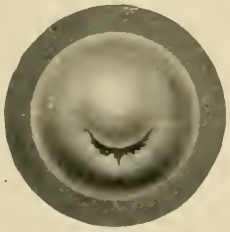


FIG. 110.—Cervix of multipara (Heitzmann).

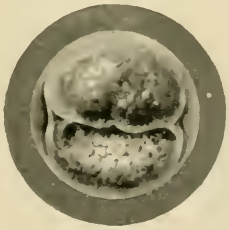


FIG. 111.—Bilateral laceration to vaginal walls with eversion (Heitzmann).

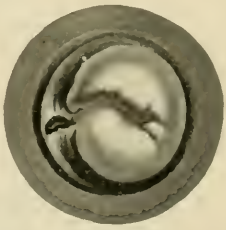


FIG. 112.—Extensive laceration involving supra-vaginal cervix and vaginal wall (Heitzmann).

but is a more or less funnel-shaped aperture placed transversely between two well-marked lips (Figs. 107–112).

It is only when these tears are excessive that they gain pathological importance. This is the case when the laceration extends upward to the vaginal vault and above it, or when it is accompanied by considerable hemorrhage. In some cases the anterior lip of the cervix is wedged in between the fetal head and the pubic arch, and it may be torn off more or less completely. By annular lacerations of the cervix (Fig. 113) are meant those very rare cases in which the external os is unyielding and in which the whole lower section

* *Monatsschrift f. Geburtshülfe und Gynäkologie*, vol. xii., No. 3.

of the vaginal portion has by the descending head been forced off in the shape of a circular flap containing the external os in its centre (Fig. 113).

Causes.—The more extensive lacerations of the cervix are almost always caused by obstetrical operations at a time when the cervix uteri is not sufficiently dilated to allow an easy passage of the fetus. In some few instances pathological changes in the tissues of the cervix are to blame for these injuries. At times the uterine contractions are so severe and frequent that they force the presenting part through the cervix before the latter has had time to dilate. Not unfrequently the administration of ergot during the first stage of labor, or rupture of the bag of waters before the os is fully dilated, has provoked these dangerous labor-pains. It is stated that prolonged labors are more fertile causes of cervical injury than rapid labors, on account of the long-continued compression of the cervical tissues.

Symptoms.—It is only in a minority of cases that there are symptoms present of sufficient gravity to lead to immediate discovery of the excessive laceration of the cervix at the time of its occurrence. Intense pain is sometimes present, more particularly in those cases in which the rent extends upward through the vault of the vagina to the neighborhood of the peritoneum. The hemorrhage, usually trifling, is now and then so severe as directly to endanger the life of the patient. When a post-partum hemorrhage is noticed while the uterus is firmly contracted a close examination must be made of the lower portion of the genital canal; if it is found that there is no lesion of the vulva or of the vagina that could cause the bleeding, it will be an easy matter to trace its origin to an injury of the cervix. If needs be the cervix may be pulled down into the vaginal orifice to allow of inspection. During the puerperal state an extensive laceration of the cervix increases the danger of puerperal septicemia and, at a later period, it may lead to chronic uterine disease.

FIG. 113.—External os and a portion of the cervix higher up, which have been torn off during delivery (Winckel).

Treatment.—The prophylactic treatment necessitates deferring all obstetric operations until the cervix is fully dilated. This waiting is not always practicable, and we often have to choose the lesser to anticipate the greater evil, but we should never operate under these conditions without the most urgent indications. The administration of ergot during labor at any time before the birth of the child is accompanied by so many dangers to both mother and offspring that no terms are too strong to denounce this nefarious practice.

Profuse hemorrhage from a tear in the cervix will sometimes be arrested by hot-water injections or by direct compression of the parts either by the

finger or by a tampon placed against the bleeding surface. In most cases, however, it is preferable to unite the torn tissues by sutures. The vagina is held open by vaginal specula or holders and the cervix is pulled down with a volsella or with a pair of Muzeaux forceps until it appears in the vulva, when the sutures can usually be applied without much difficulty (Figs. 114, 115).

Inversion of the Uterus.—By complete inversion of the uterus is meant that change of position and form in which the fundus is the lowest and the cervix the highest part of the organ, and the external surface is the internal;

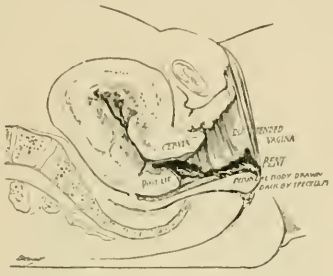


FIG. 114.—Laceration through the left side of the cervix into the broad ligament to the ischial spine and along the vagina through the perineal pyramid.

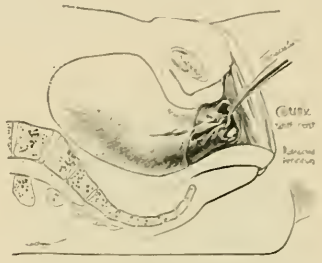


FIG. 115.—The two lower corners of the lateral laceration of the cervix seized by a double tenaculum and drawn down to make ready for suturing (Dickinson).

the shortest definition of uterine inversion is, the uterus upside down and inside out.

Varieties.—We have here to consider only what is known as puerperal inversion, and of it there are two or three varieties, according to the degree of the displacement of the organ. The first degree, constituting one of the forms of incomplete inversion, consists in cupping or depression of the fundus of the uterus. Should the fundus descend so that it is at, or partially projects from, the os, the inversion is still incomplete; but if the fundus and the body of the uterus have passed through the os, the inversion is complete. If the inverted organ is external, the vagina also being inverted, the greatest displacement is present, and it is complete inversion with prolapse. Into the funnel-shaped cavity formed by the organ internally, and lined with peritoneum, the Fallopian tubes, the ovarian ligaments, round and broad, the ovaries in part, or a portion of intestine or of omentum, may enter (Figs. 116, 117).

Frequency.—We have no conclusive statistics as to the frequency of this accident. Winckel[76] in more than 20,000 labors has not seen a case of complete inversion, nor had Braun one in 250,000. Denham in 100,000 cases of labor in the Rotunda Hospital, Dublin, found one case of inversion. Kehrer[77] states that the accident is thought to occur once in 2000 labors. Probably uterine inversion is more frequent than published reports of cases would lead one to believe. It may be that in some cases if the displacement was recognized the fact was concealed; in other instances the accident was not discovered.

Etiology.—Relaxation of the uterus necessarily precedes inversion. Mat-

thews Duncan has stated:[78] "Four kinds of uterine inversion occur after delivery:

1. Spontaneous passive uterine inversion;
2. Artificial passive uterine inversion;
3. Spontaneous active uterine inversion;
4. Artificial active uterine inversion.

The only uterine condition essential to the production of all these kinds is paralysis or inertia or complete inaction."

Without entering into the various explanations of uterine inversion given by Duncan, this accident may originate in three ways:

1. There may be spontaneous inversion. Paralysis of the uterus at the

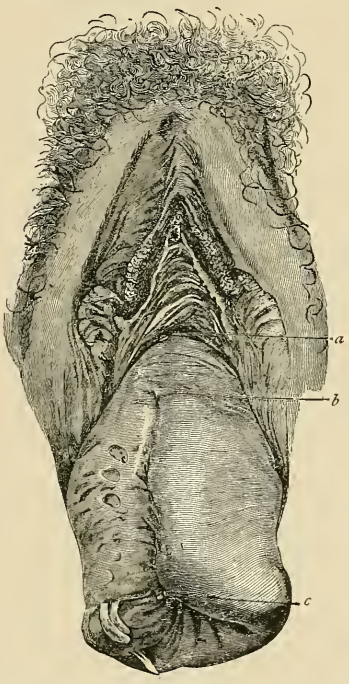


FIG. 116.—Inversion of uterus: drawing from an old specimen in alcohol. The atonic chief site of placental attachment (*c*) is shrunken by the alcohol, and thus its lessening is explained; *b*, contraction-ring; *a*, external os uteri (after J. Veit).

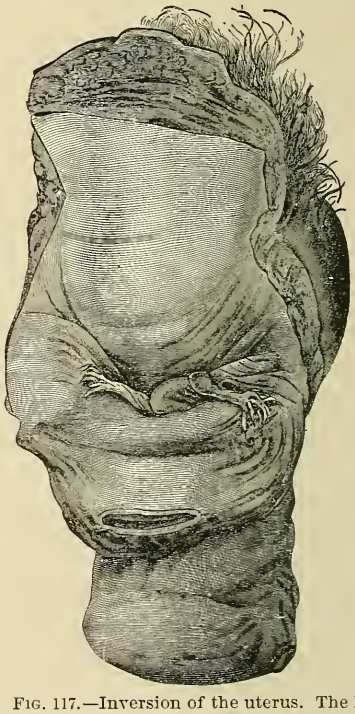


FIG. 117.—Inversion of the uterus. The lumen of the rectum is seen, and also the inversion funnel in which are the tubes and an ovary (after J. Veit).

placental site existing, simply the weight of the placenta may cause sinking of that portion of the uterus in the cavity. Such occurrence is more liable to happen if the placenta is attached at the fundus; then, the remaining portion of the uterus being active, the introcedent part becomes a foreign body, and by peristaltic action is forced farther down, just as happens in intussusception of the bowels. So, too, in complete paralysis of the uterus the organ may be inverted by the weight of the placenta. Each of these forms of spontaneous inversion is rare: some, indeed, regard them as doubtful.

2. The inversion may be caused by abdominal pressure or by the pressure

of the hand upon the uterus. Kaltenbach states that he saw an inversion produced by the practitioner, in endeavoring to express the placenta, continuing to press after the uterine contraction had ceased.* Denuce[79] quotes a passage from Galen showing that this great physician knew uterine inversion could be caused by spontaneous abdominal pressure.

3. Inversion is most frequently produced by pulling upon the cord, and this may occur in spontaneous expulsion or in extraction of the child, there being absolute or relative shortening of the funis. Again, it may happen if the child is expelled when the mother is standing, the sudden strain of the child's weight in falling, acting upon the attached placenta through the cord, producing inversion.

Much oftener, however, the uterus is inverted by improper or untimely traction upon the cord in an effort to remove the placenta, this traction being made soon after the birth of the child. The uterus may then be in a relaxed condition, and especially at this time its lower segment and the os, having been recently stretched to the utmost in the passage of the child, can oppose only slight resistance to the descent of the inverted part. It has been asserted that if pulling upon the cord was liable to cause such result, the accident would be very much more frequent, because so many obstetric attendants, especially midwives, resort to it for the removal of the placenta. But the answer to this is that such employment of traction is not usually made almost immediately after birth, and therefore the condition of the uterus, contractions having returned, cannot promote the accident. There are too many histories of inversion being caused by untimely or excessive pulling upon the cord for one to doubt that this is the most frequent cause of the accident.

While in the great majority of cases inversion occurs during the third stage of labor, it may exceptionally happen hours or days after delivery. Denuce, in describing tardy inversions, *inversions tardives*, assumes a semi-paralysis of the placental portion of the uterine wall, which becomes therefore depressed, and the depression furnishes a receptacle inviting intestinal pressure. He observes: "Such pressure, acting as in hernias, increases the extent and depth of the inverted portion and thus causes true secondary inversion." Again: "These late inversions may happen in different ways. Sometimes the intestinal pressure, acting in a continuous manner, gradually produces the inversion; sometimes, on the other hand, suddenly and under the influence of an abrupt and accidental effort or successive efforts the inversion results."

We have thus explained the fact that in rare instances competent obstetricians have met with cases of inversion when the labor was properly conducted, and at its end the uterus occupied its normal position, the displacement occurring hours or even days after. Of course in such cases no blame can be attached to the practitioner. That an inversion may begin at the cervix, as has been taught by some celebrated obstetricians, this part becoming everted

* A similar case has been previously reported by Johnston (Johnston and Sinclair's *Practical Midwifery*).

and then drawing down the rest of the uterus, is in the highest degree improbable; especially is the apparent improbability great since we have learned in recent years more of the passive character in labor of the lower uterine segment.

Symptoms.—The most important symptoms of this accident are shock and hemorrhage. The hemorrhage is inevitable if the placenta be partially or completely detached. There may be vomiting in consequence of the stretching of the nerves in the lower part of the abdomen and of the pelvis, and syncope; there may be reflex paralysis of the heart; anemia of the brain from the sudden decrease in the intra-abdominal pressure may occur. Kehrer

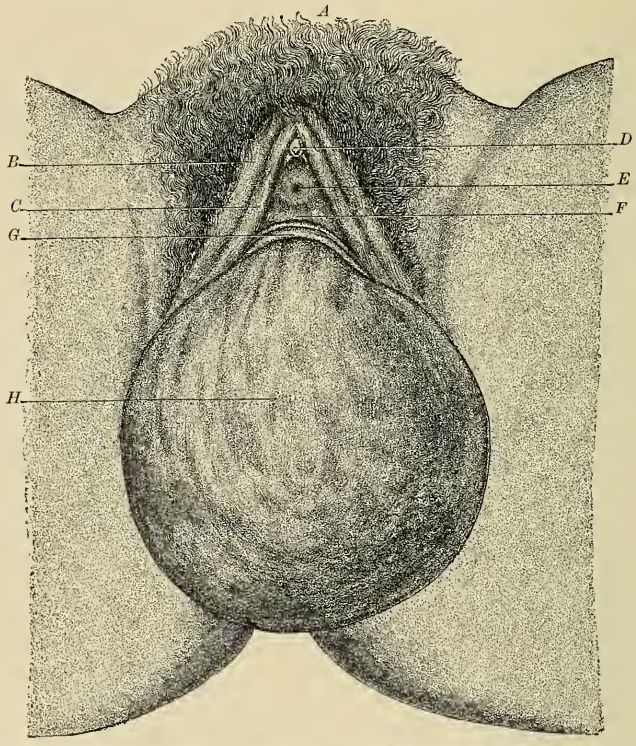


FIG. 118.—Complete inversion with prolapse (Boivin and Dugés): *A*, mons veneris; *B*, labia majora; *C*, labia minora; *D*, clitoris; *E*, urinary meatus; *F*, external anterior border of the vagina; *G*, external border of the os uteri; *H*, the internal surface of the uterus, now external.

speaks of the collapse as being anemic-nervous. If there be complete inversion with prolapse, there is in front of the vulva a large ovoidal body as represented in the illustration (Fig. 118). In quite exceptional cases inversion may occur, as asserted by Reeve,[80] "without sufficient symptoms to attract attention or to indicate that anything has gone wrong." In support of this statement Reeve, unsurpassed in obstetric knowledge and learning, adduced only two cases, both in the practice of the same obstetrician; therefore the accident thus occurring must be exceedingly rare.

Diagnosis.—If the obstetrician is present at the time of the accident, and

if the placenta is still attached, wholly or partially, to the inverted organ, a mistake is impossible. In other cases the history points to inversion, and the symptoms presented assist the diagnosis, which finally must rest upon a direct examination. This examination must be made with the greatest care, for, though in the majority of cases a correct conclusion can be reached with absolute certainty, yet mistakes have been made even by men illustrious in the profession, though these errors have usually been in the diagnosis of chronic inversion.

One of the first things for the examiner to do is to pass a catheter in the bladder, for this organ distended with urine—as it probably will be if some hours have elapsed since the accident—may be mistaken for the uterus. Moreover, the bladder must be empty in order that abdominal palpation can be made. No matter, then, what oral information may be given that the patient has recently urinated freely, let the physician know for himself, and this knowledge can be best obtained by the catheter. If the uterus is extra-vaginal, its general appearance is fairly given in the illustration (Fig. 118). More frequently, especially if the examination is made some hours or a day or two after the inversion occurred, the uterus is intra-vaginal, and by no means the size represented in the illustration. If the vagina is of normal dimensions, the hand can be readily introduced, notwithstanding the presence of the uterus. Thereby the examiner feels a soft, probably sensitive, possibly contracting, pear-shaped tumor, the larger end below. By means of one or two fingers introduced into the rectum and directed forward the funnel-shaped opening of the uterus is felt. If a sound should be passed into the bladder while two fingers are in the rectum, the ends of the latter may be brought in close approximation with the knob of the sound above the vaginal tumor. By abdominal examination the body of the uterus cannot be felt, but if the abdominal wall is not very thick and not sensitive—and the rule is that in great loss of blood sensibility to pain is much lessened—the depression formed by the entrance to the new uterine cavity can be recognized.

Denuce gives the following diagnostic marks of inversion and polypus:

1. The circular, not lateral, implantation of the pedicle;

2. The openings of the tubes upon the inferior portion of the tumor;

3. The special sensibility, sometimes accompanied by special contractility, that it offers to pressure and to acupuncture;

4. The half reduction which can always be made in inversions, never with polypi;

5. The absence of the uterus from its ordinary place, ascertained by rectal and vesical examination.

Now, we have to say as to these diagnostic marks, first, that finding the openings of the oviducts is not always easy under the circumstances, and that we know that an inverted uterus may reveal no contractility, and that it may be insensitive, possibly in consequence of the utter prostration of the subject, to pressure and to acupuncture, so that the absence of these

particular signs does not prove that the suspected tumor is other than an inverted uterus.

Prognosis.—According to Crosse,[81] one-third of the women with puerperal inversion of the uterus die either immediately or within a month. In seventy-two of 109 fatal cases collected by him death occurred within seventy-two hours, usually within half an hour. Crampton[82] in 1885 collected 120 cases; there were eighty-seven recoveries, thirty-two deaths, and one remained unrelieved. Winckel, after quoting Crosse's statistics, states that in 54 recent cases only twelve died. But even this comparatively low mortality proves that inversion of the uterus is one of the gravest accidents of labor. Patients may die from shock or from bleeding; the death may not be immediate, and then it may occur from incarceration of a loop of intestine in the inverted uterus, from peritonitis, from puerperal infection, or from gangrenous inflammation of the uterus. In very rare instances recovery has followed the separation by sloughing of this organ. Spontaneous restoration of the uterus has occasionally taken place. Schütz[83] states that ten such cases are known. Sometimes this has occurred after the failure of artificial means.

Treatment.—Of course the prophylaxis is of primary importance. Let the recumbent position be insisted upon in delivery. If brevity of the funis be recognized, promptly dividing the cord is indicated. In removing the placenta let no traction be made upon the cord, or at least no traction except during a pain. If compression of the uterus is made in efforts to express the placenta, let the obstetrician be assured that his hand is so applied to the organ that no depression of a part of its wall is possible.

The accident having occurred, restoration of the inverted organ is to be made: this restoration will be more readily effected the sooner it follows the accident. If the placenta is undetached, and especially if partially attached, it should be removed. The opinion of the majority of obstetric authorities is in favor of first removing the placenta before attempting reposition. Crampton remarks: "Firm and continued pressure upon any part of the inverted organ, the patient, if possible, under the influence of ether, will suffice in the great majority of cases to reposit a recently-inverted uterus. Thus in 92 instances of recent inversion reduction was effected in from five minutes to eight and a half hours." He gives the mortality as 20 per cent., whatever the treatment.

The restoration of the inverted uterus is best made with the hands. Of course the hands, as well as the vagina and the projecting uterus, must first be carefully disinfected. Then one hand is placed in the vagina, grasping, compressing, and pushing the organ upward, while the other hand is placed upon the abdomen, in part to make counter-pressure and in part to dilate the ring at the mouth of "the inversion funnel." In this effort the operator seeks to restore first that part of the uterus which came out last. According to Kaltenbach, the restoration is, as a rule, easily accomplished, even without narcosis.

The objection to beginning the reduction at the fundus, depressing it, and thus restoring first that which came out first, is that thereby a greater thick-

ness of uterine walls must be passed through the constriction-ring. M'Clintock[84] has said, in criticism of this method: "By proceeding after this manner we should give the uterine walls a second inflection, and we should necessarily require a greater dilatation of the constriction to admit of reposition. The accompanying diagram (Fig. 119) will help to bring out my meaning. Here *a* is the angle of inflection caused by the inversion; *b* indicates the position of the os uteri; and *c* shows how the second angle of inflection would be produced by depressing the fundus, which the dotted line represents. It would appear, therefore, that in the attempt to re-invert the uterus we should aim at replacing the part that has last come down, and so changing the angle of inflection according as each successive circle of the cervix and body is pushed up." The same objection holds if the indentation be made at one of the tubes instead of at the fundus.

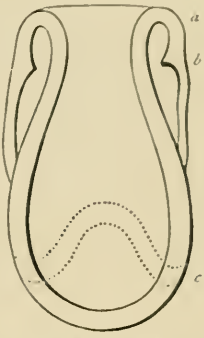


FIG. 119.—Inversion of uterus: improper method of restoration.

After the reduction uterine retraction is sought by irrigating the cavity with hot water and by the administration of ergot; packing the uterus with iodoform gauze, as some have recommended, is unnecessary. If reduction be impossible without too prolonged or violent manipulation, it is better to wait until the puerperal period has passed. A restoration immediately followed by the death of the patient can hardly be counted an obstetric triumph. Delay, too, is advisable if the patient is not seen until a few days after the accident: immediate peril has passed, and new peril may arise from active efforts at reduction made during the lochial flow. After this flow has ceased reposition may be attempted by continued elastic pressure—as, for example, by a colpeurynter filled with warm water.

If returning the uterus is impossible—and the reduction of an inversion is literally *re-turning*—it is generally advised to control hemorrhage by ergot and by local application of astringents and refrigerants. Denuce commends lactation if the patient's strength permits, stating that the hemorrhages are almost completely suppressed while she nurses.

3. Dystocia due to Diseases of the Mother.

Hyperemesis.—Excessive vomiting in labor is very rarely seen. Should it occur, however, its injurious effect is shown by weakened uterine contractions and by early exhaustion of the patient.

Etiology.—Naegele and Grenser,[95] who find the immediate cause of hyperemesis in extraordinary sympathetic excitement of the nerves of the stomach, state that it is most likely to occur in nervous, feeble persons, in the chlorotic, and in those who have previously been subject to gastralgia and to hyperesthesia of the gastric nerves. Hyperemesis may result from excessive distention of the stomach by food or by fluids. These observers refer also to a moral impression as sometimes a cause.

Treatment.—Usual means should be employed to arrest the vomiting: if it results from irritating matter in the stomach, whether food or secretions, copious draughts of warm water should be given. Sinapisms or the application of ether spray to the epigastrium, and the hypodermatic injection of morphia, will be employed; carbonic-acid water or champagne may be useful. But it is of the greatest importance that the delivery, whether manual or instrumental, shall take place as soon as practicable.

Hemorrhages.—Discharge of blood outside the genital sphere, such as epistaxis, hematamesis, hemoptysis, is occasionally seen in labor. Epistaxis, unless excessive, is to be regarded not as a complication of labor, but rather as a salutary condition relieving congestion of the head. If pulmonary or gastric hemorrhage occurs, it has been recommended that the patient should sit rather than lie upon the bed. Ice, cold acid drinks, muriated tincture of iron, and in pulmonary hemorrhage small doses of ipecacuanha, as advised by Graves, may be useful. In either form of the disease, if grave, prompt delivery is indicated. If the os is not sufficiently dilated to permit delivery with the forceps or by podalic version, *accouchement forcé* has been recommended. A case of rapidly fatal pulmonary hemorrhage in a woman at term has been reported by Budin.[29] The labor had not begun, and soon after death the Cesarean operation was performed and a child extracted that lived a few hours, and then perished with trismus.

Hernia.—Several instances of hernia causing dystocia are recorded. For example, Smellie's[30] case, No. 63, was one of crural hernia on the left side, the patient suffering from it during her entire pregnancy. In labor the hernia was forced down during every pain and gave her great uneasiness. Smellie says: "The labor being pretty far advanced when I arrived, I took the opportunity of reducing the hernia upon the cessation of the pain, pressing my fingers upon the part, and directing her to lie on her left side with her left thigh close up to the abdomen—a position which favored its keeping up and prevented the anguish which retarded the labor. She was accordingly safely delivered."

Winckel published a case in which there was a left labial hernia the size of a man's fist. In the second stage of labor, while an assistant held back the mass, the forceps was applied. Reposition was made after the labor, and retention was secured by a truss. He also saw a congenital left ovarian hernia in a parturient. The ovary, the size of a walnut, was irreducible, was not especially painful, and presented no obstacle to birth.

Smellie narrates two cases of perineal hernia. Of the one of these cases seen during labor he states: "The hernia was, however, reduced by opening the os externum, introducing my hand into the vagina, and pushing the intestine above the os sacrum." Spiegelberg, in describing vaginal enterocele, states that the hernia is almost always found at the posterior vaginal wall, and its contents are usually formed by loops of small intestine, rarely by loops of the large intestine. Smellie reported a case, occurring in the practice of Mr.

Stubbs, in which the vagina and the pelvis were filled by a tumor which probably proceeded from the intestines being pushed down at the back part of the vagina. The tumor was reduced by pressure, and the head immediately descended into the pelvis, the forceps then being applied. Dr. Hirst [31] collected 27 cases of vaginal enterocele complicating pregnancy and labor. The hernia was posterior in all except two cases. Such a hernia existing, uterine contractions may cause it to descend so low that it partially protrudes from the vulva and presents a serious hinderance to birth. The tumor is soft and compressible at the beginning of labor, and the percussion sound, according to Müller,[32] plainly indicates its character. Reposition, as successfully performed in the case reported by Smellie, is still the essential in treatment, the labor being ended by the forceps or, in case of pelvic presentation, by manual extraction.

Eventration.—When diastasis of the recti muscles occurs in an abdomen greatly distended by pregnancy, part of the uterus protrudes in the interval. This condition gives rise to inefficiency in the action of the abdominal muscles in the second stage of labor. The remedy will be found in a properly-applied bandage and in keeping the patient upon her back during the expulsive period.

Displaced Kidney.—Winckel[85] collected six cases of displaced kidney in parturient women. He refers to the fact that in this condition hinderance to labor may result from the organ entering the pelvis, thus materially lessening the size of the pelvic cavity. He advises, after replacement, as the best means of retention, having the patient lie upon the opposite side.

Tumors of the Rectum.—Jacquemier[86] states that in some cases hardened feces, resulting from long constipation or from foreign bodies such as the seeds of cherries, have been an obstacle to expulsion of the fetus. Winckel says that hard fecal masses pressed into a small pelvis may hinder the entrance of the head, cause an unfavorable position or prolapse of a member, render the examination difficult, and produce anomalies of the pains. He quotes the case of Madurowicz-Rosner, in which, the child being transverse, the examination, because of the fecal mass, was very difficult and turning was impossible, decapitation being employed.

Such an accumulation should be washed out, its removal being assisted by mechanical means such as the handle of a spoon. McClintock, in one of his notes to the Sydenham edition of Smellie's *Midwifery*, says: "I have seen the rectum distended with such a mass of hardened feces that suppositories and enemata were utterly useless to effect their removal, the anus being dilated to the size of a florin by the fecal accumulation within. Here direct mechanical means must be employed to dislodge and extract the scybala with which the gut is blocked up. This having been accomplished, then enemata of turpentine, soap, and water may advantageously be employed to clear out the lower portion of the colon and to stimulate its peristaltic action." Cruveilhier, according to Jacquemier, published a case in which the expulsion of the fetus was prevented by a cancerous tumor of the rectum. He successfully ended the labor by the forceps.

Relaxation and Rupture of the Pelvic Articulations.—In pregnancy the pelvic symphyses are swelled and softened, especially in the latter months of gestation. Budin has shown that at this time motion may be detected between the pubic bones. The physiological condition of softening may by excess become what is known as "relaxation of the joints," manifesting itself by pain at the articulation concerned and by more or less interference with locomotion. In rare instances occurring in labor there is an actual separation of the bones, a diastasis known as "rupture of the joint," the previous relaxation predisposing to this accident. Vinay [87] believes that in cases of great relaxation of these articulations articular or periarticular inflammations (arthrites) complicate the condition. Schauta [88] quotes the case observed by Gmelin, in which the autopsy showed (death having followed Cesarean section) that the pubic bones were separated 1.5 centimeters by an accumulation of yellowish serum at the place of the synovial cavity. In some cases there has been found inflammation of the cartilage, causing abnormal softening of the joint. Osteomalacia predisposes to rupture of the joints, this accident being very rare in the rachitic pelvis. Trousseau, [89] who met with several cases of this disorder, and who has admirably described it, refers to one patient in whom the separation of the pubic bones was so great that the end of the index finger could be interposed. The late Fordyce Barker [90] presented the subject in his usual clear and scholarly manner. Snelling's monograph [91] is, of course, valuable. In the American edition of Denman, [92] edited by Francis, two cases of this accident are reported by its author and two by its editor.

Pelvic contraction, great size and solidity of the fetal head, and unfavorable position have been mentioned as causes of rupture of the pelvic articulations. In one instance this accident seems to have resulted from the remarkable development of the trunk of the child, thus preventing its entering the pelvis, the forceps being required for delivery. In many cases the lesion has been attributed to the forceps, but it would seem more rational to regard the condition requiring instrumental delivery as the more important factor. Havajewicz [93] found that in 23 cases of separation of the symphysis forceps had been used in sixteen. In one of three cases reported by Remy [94] the forceps was used, but in the other two the delivery was spontaneous. The direction in which traction is made with the forceps may be a cause, as when a part of the force is exerted in the axis of the birth-canal, while the rest of the force acts upon the pelvic girdle, especially at the pubic joint: nevertheless, the accident has occurred when Tarnier's axis-traction forceps was employed.

Ulsamer [95] believed that rupture of the pelvic articulations from the forceps was much more frequent than was reported. He states that sometimes these ruptures are undiscovered, and sometimes they are kept secret, for the public is disposed to attribute the injury to the exercise of great force, although it has been proved that separation of the pelvic joints has followed the skilful use of the instrument, moderate force only being exerted; it may occur also in spontaneous delivery. Ahlfeld in 1875 collected 100 cases of lesions of the pelvic joints, and in 1888 Schauta [88] added 13 cases. Dührssen [96] has

given 33 cases in which suppuration in the joint followed the injury. The 23 cases of Havajewicz and the 3 cases of Remy have been mentioned above.

When rupture of a pelvic joint occurs in labor, it is accompanied by sudden and violent pain in the joint, the patient being conscious, it may be, of a serious tear at the painful part, and the instant yielding of resistance, so that the presenting part rapidly advances. Moreover, a "crack" is heard not seldom by those near the patient. Sometimes, as in a case of Remy's, the labor ends without any indication of the injury, which is made known in some movements of the patient a short time afterward, there having been a silent rupture. According to Schauta, the accident most frequently involves the pubic and the right sacro-iliac articulation; then the pubic and the left sacro-iliac articulation. Rarely are the two sacro-iliac articulations affected without the pubic.

Direct examination of the pubic joint with two fingers or with the thumb and finger, one external and the other internal, will detect the injury. Further, the lower limbs, the patient being recumbent, will be everted. Trousseau called attention to the fact that "loosening of the pelvic symphyses" may be mistaken for disease of the spinal cord; and Remy remarks that "relaxation of the symphyses may involve functional impotence of the inferior members so pronounced that it may be believed there is a real paraplegia." Should the injury not be detected at the time of its occurrence or while the patient is in bed, it is recognized when she gets up and attempts to walk; if she succeeds, she, as Trousseau states, waddles, dragging one leg after the other and leaning greatly to the right or the left according to the foot she advances. Barker found that one of his patients could stand with comparative ease resting upon either leg, but could not balance herself upon both legs at once. If this accident occurs in labor, it is important to redouble antiseptic precautions, so that all danger of infection shall be averted so far as possible. If suppuration follows the injury, it is essential, as urged by Dührssen, that the purulent collection shall promptly be evacuated.

In one of the 13 cases given by Schauta the urethra was torn, and in another the bladder and the vagina. Four of the women died, but perfect recovery occurred in the others, save one who was bedridden, at the end of twelve months. The period of recovery varied from a few weeks to several months. In the case occurring to Havajewicz death followed on the nineteenth day, delivery having been made with forceps. The child, which was unusually large, perished half an hour after birth. In Dührssen's 33 cases of suppuration following rupture only seven recovered of twenty-four treated without incision, while of nine in which this treatment was employed all recovered.

The essential treatment of rupture or of great relaxation of the pelvic articulations is a firmly-applied bandage encircling the pelvis. "A girdle requires to be placed around a pelvis which has its staves separated. It is necessary to supply the temporary deficiency of intrinsic contention by an

extrinsic contention—that is to say, by the tight application of a bandage in such a way as to bring into contact the separated surfaces of the symphyses" (Trousseau). Most authorities * agree that a towel answers well for a pelvic girdle. The union of the joint may take place in from ten to fourteen days, but sometimes several weeks or even months are required.

Diseases of the Heart.—Cardiac disease is not uncommon in pregnant women, the most frequent form being valvular, the mitral valve being oftenest involved. The longer the lesion has existed and the more incomplete the compensation, the greater the liability to premature arrest of the pregnancy. This accident was observed (Vinay) in ninety-two of 220 cases, according to the statistics of Courréjol united with those of Porak.

The question of the interruption of pregnancy is determined by the condition of the patient. Fehling [88] includes among the indications for inducing premature labor chronic bronchitis with great pulmonary emphysema and insufficiently compensated cardiac disease. Kaltenbach, too, makes uncompensated valvular disease of the heart an indication. Vinay [88] states that in the severe forms marked by gravido-cardiac accidents, when bronchitis is united with pulmonary congestion and edema, and there often supervene visceral congestions, anasarca, and ascites, and the dyspnea is constant, preventing nourishment and sleep, energetic intervention becomes necessary. "Peter insists upon the good effects of bleeding, which is immediately useful in calming the distress and dyspnea. There may be added inhalations of oxygen, subcutaneous injections of caffeine and ether, infusion of digitalis or digitalin. But it often happens that the disorders of compensation cannot be ameliorated by medical treatment, and the life of the patient is in peril from increasing dyspnea and the cardiac asthenia; it is then necessary to induce labor." In a recent valuable monograph by Allyn [97] the author states that labor should be induced when dangerous pulmonary symptoms persist in spite of suitable treatment; he further advises bleeding before labor is induced. Winckel regards induction of labor as uncertain in its effect upon the disease of the mother, and says that it ought to be restricted to the severest cases.

When labor occurs it is agreed that anesthesia may properly be employed, chloroform being preferable to ether, and that the travail should be ended with as little exertion on the part of the mother as possible. If the forceps is used, it is advised that extraction be made slowly, to avoid sudden lowering of the intra-abdominal pressure. To compensate for this lessened pressure following birth, Lahs and Fritsch [88] recommend bags of sand upon the abdomen.

Dr. Webster [98] advocates chloroform as *the* anesthetic in labor; he states that occasional *hypodermics* of ether may be required, and especially recommends nitrite of amyl as first tried by Fraser Wright, capsules containing 4 or 5 minims being broken and the drug being held to the patient's nose. "It

* It is remarkable that Meigs should have found "every attempt at bandaging a failure, on account of the impossibility of well adjusting and properly retaining a bandage in place in this particular part of the body, so that I am obliged to conclude that the best thing that can be done is to go to a protracted rest in bed."

is also useful in opposing the tendency to chloroform syncope." "As the child is delivered the nitrite of amyl is of great value in neutralizing the increasing strain on the heart due to the additional blood thrown out of the uterine circulation as a result of the uterine retraction which follows delivery." He further advises that during the third stage of labor artificial detachment of the placenta be made by a hand passed into the uterus, securing a certain amount of hemorrhage, and warns against the delivery of the placenta by the Credé method, and also against the administration of ergot.

Diseases of the Brain.—Winckel states, referring to meningitis in pregnancy, that when labor begins the condition is aggravated and the severe headaches may end in convulsions, but the urine is free from albumin. He refers to Hecker's case of tubercular meningitis, the restlessness of the unconscious patient becoming so great with the occurrence of labor-pains that the labor was artificially ended. Of the 35 cases of paralysis collected by Churchill,[99] in twenty-three the attack occurred during pregnancy, and in twelve either during or after labor. In this number there were thirteen cases of hemiplegia, partial or complete, occurring before or during labor: these cases were obtained from Lever, Stokes, Crosse, Simpson, and M'Clintock. Imbert-Gourbeyre in his well-known monograph reports several cases of hemiplegia occurring in pregnancy, and he states that in more than half the cases *des paralyses obstetricales* the paralyses are manifested during pregnancy, and that in two-thirds the patients are hemiplegic. In 1872, Charpentier[100] collected 172 cases of puerperal paralysis, and of these there were fifty-seven hemiplegias to forty-five paraplegias. The causes of hemiplegia were chiefly cerebral lesions and failure of renal action.

In quite a large proportion of cases, if the hemiplegia occurs during pregnancy, either premature labor or, in some cases, abortion occurs. In these patients there is usually albuminuria. In very many of the cases a fatal result occurs, twenty out of fifty-seven dying, according to Charpentier's statistics. It is only exceptionally that the labor is protracted in the hemiplegic. La Motte (Observation CCXIX.)[101] gives, in his usual graphic manner, the history of a woman attacked with convulsive movements three days before labor; they were followed by loss of speech and almost entire loss of consciousness. When the labor began he recognized it by some contractions of the lips and slight movements of the pelvis during a pain. The woman was safely delivered, but there was complete paralysis of the right side; the patient slowly convalesced, so that at the end of six months she was able to go to the waters of Bourbon, where the cure was completed. The chief argument of La Motte that the patient had not true convulsions, though she had convulsive movements, was the fact that the child lived, whereas in true convulsions it would have been dead when so long a time passed before labor. He regarded the disease simply as apoplexy. Hemiplegia occurring during labor will most probably result from cerebral hemorrhage in connection with eclampsia, and it then presents an additional argument for prompt artificial delivery.

Paraplegia.—In paraplegic women the anesthesia of the abdominal wall

may be so complete that the subject is never conscious of the movements of the fetus and does not feel any pain in labor (Vinay). "In a patient of Bernhard's affected with progressive locomotor ataxia labor passed almost entirely without the patient's knowledge, suffering being felt only when the head was disengaged. In a case published by F. Benicke the patient had Pott's disease with compression of the cord. The accouchement took place at term without suffering, and so unexpected was it that the woman was first advised of the labor by the crying of the child." A patient of Bernays,[102] a victim of syphilis, was "totally paralyzed in her lower limbs and in all the muscles of her trunk which are supplied by nerves originating from the cord below the seventh cervical vertebra." The entire labor lasted only about thirty minutes, and its "peculiarity was, that in place of the usual interrupted labor-pains, there was but one continued contraction of the uterus, which resulted in the expulsion of a large, well-formed, healthy child." In Epley's patient[103] delivery was effected by forceps after labor had lasted a day. In the case reported by Litsckus,[104] the woman suffering from progressive locomotor ataxia, the labor was very slow, lasting five days. Gamet, quoted by Vinay, states that the final period in labor may be long in overcoming the resistance of the perineum—not from the muscles which are paralyzed, but of the aponeurotic and fibrous parts.

Shock.—If shock occurs to a woman in labor, it is most frequently the result of a grave accident—for example, rupture of the uterus. Apart from the causal treatment of the condition, the practitioner should seek to obviate the tendency to death and to bring about reaction as soon as possible. Among the means he may employ are the external application of heat, alcoholic stimulants, ammonia, camphor, and the hypodermatic use of sulphuric ether and of strychnia.

Labor in Pneumonia.—By most obstetricians the occurrence of labor in a patient suffering with pneumonia is regarded as very unfavorable, and they therefore seek to avert any threatening of this event; but if parturition is inevitable, the latter is facilitated as much as possible. Great encroachment upon the chest-cavity by the uterus may be lessened by early rupture of the membranes, and the injury to the already overtaxed heart by labor-pains is avoided as soon as possible by artificial delivery.

Sudden Death in Labor: Delivery of the Child.—The chief causes of sudden death of the parturient are apoplexy, eclampsia, rupture of the uterus, of the heart, or of the aorta, exhaustion from protracted labor, uterine hemorrhage, pulmonary embolism, and, quite rarely, rupture of the spleen.

In sudden death in labor it is important that the child be delivered promptly. If the dilatation of the os is sufficient, the application of the forceps is indicated in vertex presentation; in that of the pelvis, the immediate bringing down of one or both feet, and extracting. According to Kaltenbach, not even one-tenth of the children delivered after the death of the mother live. He quotes Puech's statistics showing that in 453 operations one hundred and one children gave signs of life, but only forty-five survived.

Nevertheless, though the child be dead, its delivery should be made, "out of consideration for the relatives and friends of the woman and for the profession to which we belong, especially if the accoucheur has been in charge of the labor for some time and has already made attempts at delivery" (Spiegelberg). Some advise that when the mother is dying from pulmonary tuberculosis, from severe apoplexy, or other hopeless disease, delivery be made while she is yet alive, if consciousness and sensibility are lost.

If the mother die from slow asphyxia or from hemorrhage (either uterine or from rupture of the heart or of a large blood-vessel), the probability of saving the child is very slight, but if her death be from a sudden injury, from embolism, or from apoplexy, the chance of the child's living is greatly improved. It is usually held that if more than ten minutes intervene between the death of the mother and the extraction of the child, its living is doubtful; yet there are a few cases in which this period was considerably passed and the child was extracted alive.

As proving that in some cases a much longer period than ten or fifteen minutes may intervene between the death of the mother and the removal of a living child, the following facts are of value:[105] During the Commune of Paris, Tarnier one night at the Maternity was called to an inmate who, while lying in bed near the end of pregnancy, had been killed by a ball which fractured the base of the skull and entered the brain. He removed the child by the Cesarean operation, and it lived for several days. He states that the delivery may have taken place three-quarters of an hour, or even an hour, after the death of the mother. In another case a pregnant woman fell to the pavement from a window a distance of more than 30 feet, instant death resulting; thirty minutes at least after the death of the mother an infant was removed, which after some difficulty was resuscitated, and which lived for thirteen years. Tarnier also quotes the case, recorded by Hubert, of a successful Cesarean operation two hours after the mother's death: the woman, who was eight months pregnant, was instantly killed by a locomotive while crossing a railroad track.

In case the os be not sufficiently dilated for immediate delivery, Depaul stated that he could not too much insist, with almost all those who have studied this question, upon the advantages offered by extraction of the infant *per vias naturales*. One need not fear multiple incisions of the cervix by a bistoury; there can thus be obtained in a few seconds dilatation sufficient to make version or to apply the forceps. Thévenot[106] states that the advice to deliver the child, in case the mother dies in advanced pregnancy, by the natural passage was first given in 1665 by Schenk. He quotes Baudelocque, Gardien, and Velpeau as having approved of this method. One advantage of it is that there need be no delay in case the evidence of the mother's death is not conclusive, and such delay in the Cesarean operation may be fatal to the child. It should be remembered that in several cases—not, however, occurring in recent years—the operator was startled by finding his subject only apparently dead. In case the Cesarean operation is selected, the same precautions are to be employed as if operating upon the living subject.

Aveling [107] collected 44 cases in which spontaneous expulsion of the child occurred after the death of the mother. The force concerned in such expulsion is usually the gases arising from decomposition accumulated in the abdominal cavity, causing pressure upon the uterus, or such gases in the uterus itself. It has, however, been claimed that in some cases expulsion of the fetus was caused by contractility of the uterus continuing after the death of the mother, while the resistance of the pelvic floor was lessened. Post-mortem inversion of the uterus may occur from gases resulting from decomposition in the intestines, the organ protruding from the vulva. Kaltenbach mentions a case in which a woman died from hemorrhage, the cause charged being the midwife's pulling upon the cord. Four weeks after death the body was exhumed and the inverted uterus was found in front of the vulva. Kaltenbach explained the inversion as post-mortem, and the midwife was acquitted.

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IV. THE PUERPERIUM.

I. PHYSIOLOGY OF THE PUERPERIUM.

The puerperium is the period of convalescence from childbirth. It begins with the close of the third stage of labor, and ends with the regressive changes which take place in the uterus and other genital organs after parturition. This process usually occupies six weeks; in exceptional cases it is not complete until the eighth or tenth week.

The condition of the puerperal woman has been aptly compared to that of a wounded patient. While not sick, she is "eminently predisposed to disease." The exhaustion following labor, the wounds and contusions of the birth-canal, the presence of putrescible fluids in the passages, together with the resorption activity of the utero-vaginal tract, are conditions which border closely upon the pathological, and are an ever-present menace to the safety of the post-partum state. The exalted irritability of the nervous system, too, contributes to the unstable equilibrium which characterizes the childbed condition. The puerperal process, therefore, though a physiological one, demands the constant exercise of care and skill in its management to prevent the invasion of disease.

Post-partum Chill.—A sense of chilliness, or even a distinct rigor, is frequently experienced at the close of labor or during the third stage. It is of short duration, rarely exceeding ten minutes, and is not attended with rise of temperature. The probable cause of the chill is the lessened heat-production due to the abrupt cessation of muscular effort after the expulsion of the child, and the rapid loss of heat by evaporation from the lungs and skin. It has no pathological significance, and requires no treatment except warm coverings and possibly a hot drink.

The Pulse.—Soon after delivery the pulse-rate, which has been somewhat increased during labor, falls, as a rule, below the usual normal standard. This retardation of the pulse generally begins within from eight to forty-eight hours after labor, and in exceptional cases continues until the end of the second week. Usually it lasts for a period of not more than three or four days in primiparæ, somewhat longer after subsequent births. The duration of the reduced pulse-rate is generally prolonged in proportion as the reduction is more marked. The frequency most commonly observed is from fifty to seventy per minute; rarely a minimum of forty or less has been noted. This alteration in the pulse is not attended with a corresponding variation of temperature. The cause of this phenomenon is doubtless connected with the mental and physical rest which follows delivery, and the sudden diminution in the amount of labor put upon the heart in consequence of the interruption of the utero-placental circulation. For several days after childbirth the frequency of the pulse is variable under slight disturbing influences.

The Temperature.—At the close of labor the temperature ranges from one

to three degrees above the normal, according to the length and severity of the labor. Within twelve hours it falls again nearly or quite to the usual standard. In twenty strictly normal cases selected from the writer's hospital service the average temperature at the close of labor was 99.67° F., the maximum being 100.5° and the minimum 98.4°; at the end of twelve hours the average temperature was 99.18°; twenty-four hours after labor it was 98.65°, the maximum being 99.5° and the minimum 98° F.

For the first four or five days of the puerperium 99.5° F., and for the balance of the period 99° F., should be regarded as the physiological upper limit of thermometrical range. Transient elevations of temperature, however, may occur from comparatively unimportant causes, such as emotional excitement, digestive disturbances, or constipation. A slight rise is sometimes observed on the establishment of lactation if the breasts are much engorged and painful. This rise is most likely to occur in debilitated and weakly women and in those unable to nurse. A temperature persistently above the foregoing limits must be regarded as evidence of some complication.

Secretions and Excretions.—The general effect of labor upon both secretions and excretions is to increase the activity of these functions. The skin acts freely. If the body is kept warm, perspiration is usually profuse. Hyperemia of the skin and consequent exudation into the hair-follicles sometimes result in partial loss of hair.

There is a notable increase in the volume of urine during the first week. Its specific gravity is a little lower than usual, the amount of water eliminated being greater than during pregnancy, while the total excretion of urinary solids *per diem* remains nearly or quite unchanged. This superabundant secretion of urine is one of the causes of over-distention of the bladder to which the patient is exposed after labor (Fig. 120). Other contributing causes of retention in the first few days are the posture of the patient, the lessened intra-abdominal pressure, urethral spasm, and the dread of pain during micturition owing to the bruised and fissured condition of the vesical neck, the urethra, and the vulva.

Glycosuria is observed in a considerable proportion of instances for a short time after as well as before labor. This is due to resorption of lactose, and the proportion of sugar in the urine fluctuates with the fulness of the breasts. It disappears as soon as the balance is established between secretion and consumption. Peptonuria exists for several days, peptone being a product of uterine involution.

Loss of Weight.—It is stated that during the first puerperal week there is a loss of weight, variously estimated by different observers at from one-twelfth to one-eighth the body-weight at the close of labor. This loss is attributed to the increased activity of the secretions and excretions and the small amount of food ingested during this period, together with the retrograde changes which normally take place in the pelvic organs. Under the present practice of allowing the patient a moderately full diet after labor the loss is generally confined to the first few days post-partum, and is soon made good.

Uterine Contractions.—Rhythmical uterine contractions, similar to those of labor, continue for a variable length of time after the delivery of the placenta.

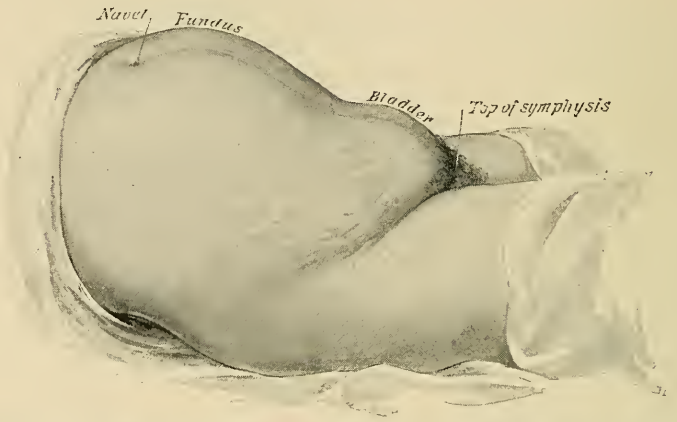


FIG. 120.—Extreme over-distention of the bladder during labor (from a sketch by R. L. Dickinson, M. D.).

The contractions of the uterus tend to exclude blood-clots from its cavity, to establish complete retraction, and thus to accomplish the permanent ligation of its vessels: by diminishing the blood-supply they promote in the uterus the retrograde changes which normally take place in the puerperal period. In primiparæ they are seldom painful. In multiparæ, in whom there is greater relaxation of the uterus and greater tendency to the retention of clots, they are more intense and are frequently accompanied with pain. After-pains in exceptional cases may continue for two or three days. Usually they cease after a few hours. They are intensified when the child nurses by the reflex influence of the mammary irritation. Even in women who have borne children they are, to a great extent, prevented by the use of measures to secure full and persistent retraction of the uterus immediately after the expulsion of the placenta.

Sometimes uterine contractions of a painful character occur, without the retention of clots, from purely neurotic causes. Pains of unusual severity, unduly prolonged and accompanied with great sensitiveness to pressure, may suggest the possible presence of beginning peritonitis.

The Digestive Organs.—Usually the appetite is diminished for the first few days after labor and the digestive powers are enfeebled. Owing to the rapid elimination of fluids by the skin and the kidneys, thirst is increased. The bowels act sluggishly in consequence of the small quantity of food ingested, the increased secretory activity of the skin, the diminished peristalsis, the lessened tonicity of the abdominal muscles, and the complete rest in bed.

GENITAL ORGANS.—*Condition of the Parturient Tract.*—By palpation over the lower portion of the abdomen at the close of labor the uterus may be felt as a hard, irregularly rounded mass reaching about halfway from the pubic bones to the umbilicus. Owing to the relaxation of the abdominal

walls, the fundus may be grasped in the hand, and even the round ligaments and ovaries can generally be mapped out. Within a few hours the uterus will be found somewhat relaxed, with the fundus at the level of the navel or a little above it. Usually it is slightly anteflexed, and its position is one of partial dextroversion and dextrotorsion. It is somewhat larger in multiparæ than after the first confinement. The placental area is somewhat elevated; its surface is uneven, and is studded with thrombi lying in the mouths of the utero-placental vessels. The outer layer of the decidua and fragments of the inner layer remain for a time, to be gradually cast off with the lochial discharge. A layer of blood or bloody mucus covers the entire wall of the uterine cavity. The cervix remains soft and relaxed for several hours after labor, having an almost gelatinous consistence. Its length is $2\frac{3}{4}$ inches or little more. The os internum presents the feel of a resisting ring, and in the intervals between uterine contractions it is sufficiently open to admit two or three fingers.

The lower border of the cervix is always bruised and fissured, sometimes deeply torn. After twelve hours the neck of the uterus begins to regain its former shape. Even in the absence of notable lacerations the vagina and vulva are swollen, abraded, fissured, bruised, and sensitive to the touch. For two or three days there is frequently more or less edematous swelling of the labia. The hymen in primiparæ is torn at numerous points, its fragments skirting the vaginal orifice as small projections which ultimately form the caruncule myrtiformes. The vulvar orifice gapes more or less according to the extent to which the soft structures have been overstretched or torn during the birth (Pls. 42, 43).

Involution.—In all the pelvic organs which have undergone hypertrophy during pregnancy a corresponding atrophy of the tissue-elements takes place during the puerperium. This process affects the ovaries, the Fallopian tubes, the uterine ligaments, the vagina, the external genitals, and especially the uterus. Except in primiparæ the pelvic structures are in normal conditions fully restored to the pre-gravid state. After the first labor the return to the virgin condition is never complete, particularly in the uterus and the vagina. The enlargement of these organs remains in some degree permanent.

The Uterus.—The uterus, as the principal seat of the building-up process during gestation, undergoes the most important retrograde changes in course of the lying-in period. The rate of uterine involution is shown in the following tables. According to Heschl, the weight of the uterus is—

At the close of labor,	770 to 805	grams.
" end of the first week,	665 to 735	"
" " " second "	350 to 385	"
" " two months,	45 to 75	"

According to Kaltenbach, the organ immediately after labor weighs about 1000 grams (2 pounds).

The uterus measures at the close of labor from 19 to 21 centimeters ($7\frac{3}{5}$ to $8\frac{2}{5}$ inches) in length, and 11 centimeters ($4\frac{3}{8}$ inches) in width at the level of

the Fallopian tubes, and its upper segment is from 3 to 4 centimeters ($1\frac{1}{5}$ to $1\frac{3}{5}$ inches) in thickness. The cavity is from 15 to 18 centimeters (6 to $7\frac{1}{4}$ inches) in depth. The following sound measurements are from Hansen:

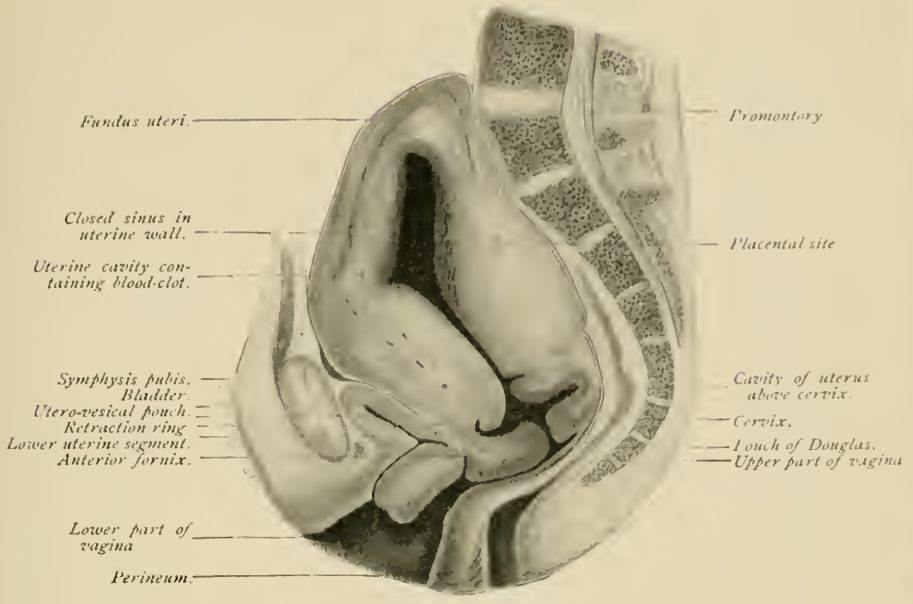
Tenth day,	8. to 13.5 cm.	Sixth week,	6.2 to 9.1 cm.
Fifteenth day,	8.3 to 11.5 "	Seventh "	6. to 8.5 "
Third week,	7.5 to 10.5 "	Eighth "	5.6 to 8.5 "
Fourth "	7. to 9.3 "	Tenth "	5.4 to 7.5 "
Fifth "	6.5 to 9. "		

The fundus uteri lies about midway between the umbilicus and the pubic bones at the close of labor. Within a few hours it is just above the umbilicus, and is at the level of the pubic bones by the tenth day. The elevation of the fundus, however, varies with the fulness of the bladder and the rectum. The uterus is pushed up bodily when these viscera are distended.

Involution is retarded in non-nursing women, after twin births, much hemorrhage, retention of secundines, sepsis of the endometrium, or getting up too soon.

Uterine Muscularis.—Various theories have obtained with reference to the nature of the changes in the uterine muscular structure during involution, some authorities holding that a part, others that all, the muscle-fibres are destroyed by a process of acute fatty degeneration, and that there is partial or total re-formation of muscle-elements. Sänger has shown by a large number of observations that the regressive process is one of atrophy, by which the muscle-fibres are reduced to their primitive dimensions. The muscle-fibres are not destroyed by complete fatty degeneration: they undergo a true involution until they have reached their earlier size and form. Similar conclusions have been reached by Dietrich. The nutritive activity in the uterus is greatly diminished by the lessened blood-supply consequent upon uterine retraction after labor, and atrophy ensues, fat-globules appearing only in the interior of the muscle-cells and never externally to the fibrillæ. The fat-globules "do not enter as such into the circulation, but are oxidized in the place where they occur. The intermuscular connective tissue experiences a similar involution in its cellular and fibrillar elements."

Blood-vessels of the Uterus.—Thrombosis takes place in some of the sinuses at the placental site during the ninth month of pregnancy. The remaining ones are promptly closed by compression and by the formation of coagula after labor. A portion of the blood-vessels become atrophied as the result of pressure. Fatty degeneration takes place in the media. The larger arteries are partially or wholly obliterated by connective-tissue proliferation of the intima. In women who have borne children the coats of the uterine arteries remain permanently thickened and the arteries larger than in the nulliparous uterus. The walls of the venous sinuses are thickened and convoluted for several weeks after delivery; the location of the placental site is discernible many months after labor. The mucous membrane is studded with pigmentary deposits, an unfailing sign of recent childbirth.



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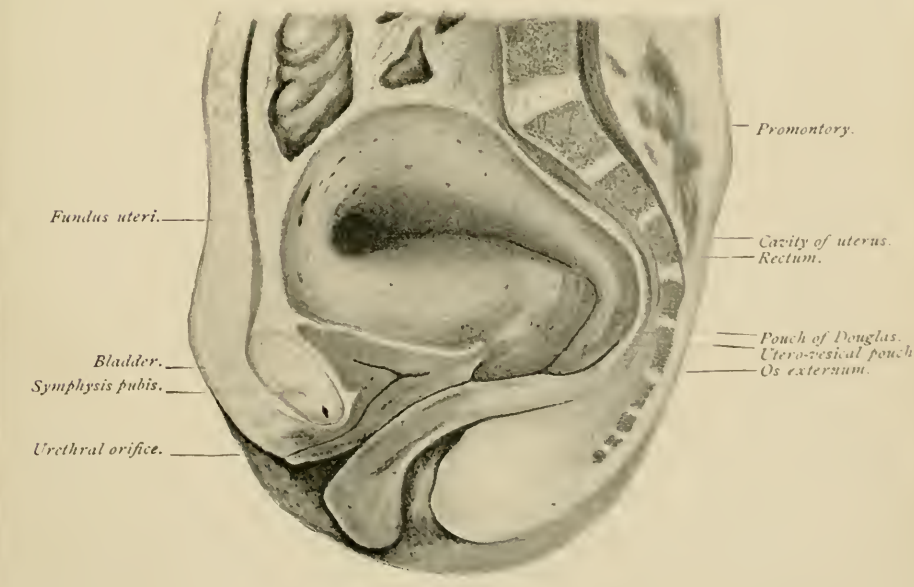
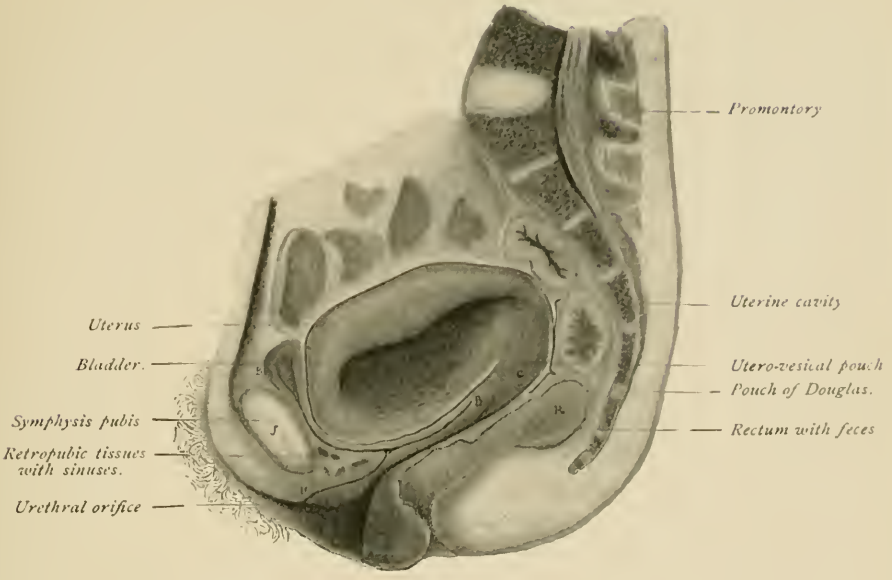


2

1. Vertical mesial section of uterus at close of labor, five minutes after delivery (after Webster). 2. Vertical mesial section of uterus, second day of puerperium (after Webster).



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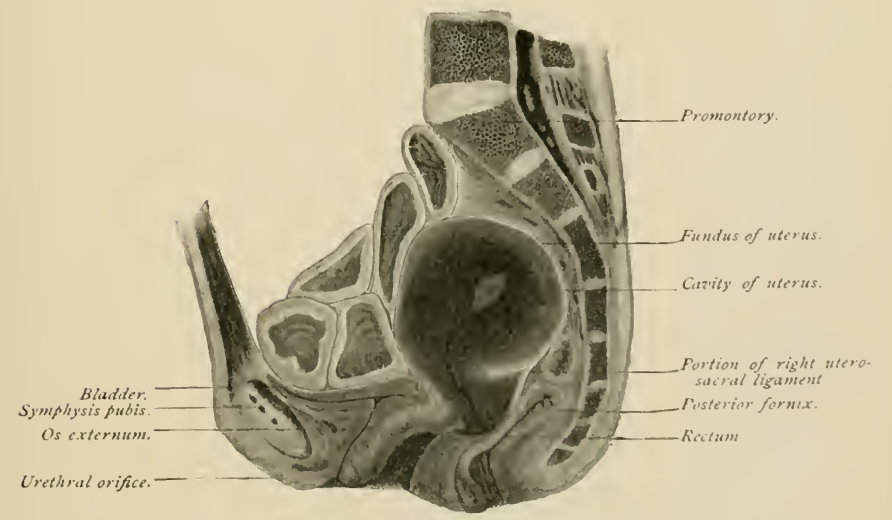


2

1. Vertical mesial section of uterus, sixth day of puerperium (after Webster). 2. Vertical mesial section of retroverted uterus, fifteenth day of puerperium (after Webster).

Reconstruction of the Uterine Mucosa.—The deep glandular layer of the decidua, together with fragments of the superficial layer, remains attached to the uterus after the expulsion of the placenta. From the glandular layer the regeneration of the mucous membrane takes place. All the remaining decidual structure not concerned in the development of the new mucous membrane suffers fatty degeneration and is gradually thrown off in the lochial discharge. The glands are crowded close together by the uterine retraction. About the mouths of the glands islands of new epithelium are formed, developed from the gland fundi. These coalesce until the surface of the uterine wall, including, last of all, the placental area, is covered. By the end of the fifth week, as a rule, the new mucous membrane is complete.

Lochia.—The genital discharges of the puerperium are termed the *lochia*. They have their origin in the cavity of the uterus, and continue during the greater part of the period of involution. They consist at first of blood with clots and decidual shreds, and usually are of a distinctly bloody character for three or four days—*lochia rubra* or *cruenta*. During the next two or three days they are pale in color, are thinner, and consist mainly of serum—*lochia serosa;* they contain blood-corpuscles, epithelial cells, and shreds of decidua. Finally, after about seven days, the discharges assume a grayish or a yellowish color and are of a creamy consistency—*lochia alba*. The microscopic elements are chiefly leucocytes, new epithelial cells, connective-tissue cells, fat-globules, and cholesterin crystals. The reaction of the lochia is neutral or alkaline during the first week; later it is acid. The discharge gradually diminishes in quantity, ceasing altogether by the end of from two to six weeks. The average amount for the first eight days is about three and a quarter pounds; the quantity, however, varies. It is greater in multiparæ than after first labors; it is more abundant and lasts longer in non-nursing women and in those who menstruate profusely. There is frequently complete or partial suppression of the flow on the establishment of the milk-secretion. The lochia rubra persists longer in retroversion of the uterus and after getting up too soon. Normally, the lochial discharge has only a faint odor and is never fetid.

Even in normal conditions micro-organisms are found in the genital discharges after the first two or three days. Their abundance varies in different cases and increases with the progress of the flow. The principal varieties are single cocci, staphylococci, and bacilli. Their occurrence in the lochia is explained partly by the presence of bacteria primarily in the vagina, partly by entrance from without. The uterine lochia, as a rule, are free from bacteria in normal cases.

Lactation.—Important changes in the mammary glands take place during pregnancy in preparation for lactation. They become enlarged by growth of the acini, by interlobular deposit of fat, and by swelling and proliferation of connective tissue. In the later months of gestation a milky serum may be expressed from the nipples. The mammary secretion of the first days of the puerperium is similar to that of the latter part of pregnancy, and is termed *colostrum*. It is a viscid fluid of a faint lemon-yellow color, and is richer in

fat, sugar, and the inorganic salts than the fully-developed milk-secretion. At this early period, before the function of the gland-cells is established, it is little more than a transudation from the blood. Accordingly, there is a preponderance of albumin and a deficiency of casein. Its chief microscopic elements are fat-globules, mucous corpuscles, pavement epithelium, occasional milk-corpuscles, and large round granular epithelial cells, known as *colostrum-corpuscles*. The latter do not wholly disappear for several days after the true milk-secretion is established. The laxative property of colostrum is attributed by Winckel and others to the abundance of phosphate of calcium, chlorids of sodium, potassium, and magnesium in its composition. The large proportion of fat and of milk-sugar doubtless contributes to the cathartic action. De Sinéty ascribes the laxative effect of colostrum to its indigestibility.

The true milk-secretion begins usually on the second day in multiparæ, on the third day in primiparæ. The mammary glands become swollen and more or less painful, the veins are prominent over the breasts, and the axillary glands are frequently enlarged and sensitive. Some general disturbance is experienced in the presence of great tension and pain in the breasts, particularly in nervous women. Thirst, loss of appetite, malaise, and, in exceptional cases, a slight elevation of temperature, may be observed on the development of the milk-secretion.

True milk fever, it is generally conceded, does not exist. That painful engorgement of the breasts, however, may give rise to transient fever in the condition of unstable equilibrium which characterizes the puerperal woman cannot be doubted. Yet it must not be forgotten that a rise of temperature at this time may be, and most frequently is, due to septic absorption from the genital wounds.

Human milk contains on an average 1.5 per cent. of albuminoids, 4 per cent. of fat, 7 per cent. of sugar, 1.4 per cent. of inorganic salts, and 86 to 87 per cent. of water. These proportions, however, are subject to considerable fluctuation. They are affected by the health and habits of the woman, and even by emotional disturbances, and they vary, too, with the period of lactation. There is an excess of proteids until the second month; thereafter they diminish until the ninth month. The fat and the sugar increase till the end of the first month. From that time there is normally little variation in these ingredients until the eleventh month, when they begin to diminish. Authorities, however, are not agreed on the nature and the extent of the changes which take place in the composition of breast-milk from month to month.

The composition of the lacteal secretion departs somewhat from the usual normal standard on the return of the menstruation. These changes are generally of short duration, lasting but a few days after the menstrual period. In exceptional cases they remain to a greater or lesser extent permanent. Frequently no harm comes to the mother or the child from the continuance of nursing even when the menstrual function is resumed in the early weeks of lactation; in exceptional instances it may be necessary in the interests of the child, and possibly of the mother, to discontinue nursing.

The liquid portion of milk is derived, with some modification, from the blood; the fat, sugar, and casein are products of the metabolic changes in the protoplasm of the secretory cells of the mammary glands. The fat or butter is held in suspension in the liquid portion in minute globules of variable size, forming a fine emulsion.

The average normal period of lactation is about one year. In most nursing women, however, the milk begins to fall off in both quality and quantity after the seventh or eighth month. Both the abundance and the duration of the secretion vary greatly in different cases according to the health and vigor of the woman. In normal conditions the quantity increases during at least the first six months proportionately to the needs of the child's nutrition. In non-nursing women the secretion continues for a few days, then rapidly declines, and soon ceases altogether, the parenchyma of the gland undergoing involution.

II. DIAGNOSIS OF THE PUERPERAL STATE.

The puerperal condition can usually be recognized with little difficulty within the first one or two weeks; later the diagnosis is not so readily established. The evidence of recent delivery is to be sought principally in the condition of the breasts, the abdomen, and the genital tract. After the first two days the breasts are enlarged and tense. The mammary glands are firm and nodular and milk is freely secreted.

The abdominal walls are lax, and the skin can be taken up in folds over the underlying muscles; *striæ gravidarum* and the pigmentary changes are evidence that advanced pregnancy has at some time existed, other causes of abdominal enlargement sufficient to explain the presence of striæ being excluded. The external genitals are gaping, swollen, bruised, and fissured for several days after childbirth, and for at least two weeks they present the marks of recent injury of greater or lesser degree. The vagina is enlarged and relaxed; the rugæ are effaced and the introitus stretched and torn. The uterus is enlarged, the cervix is notched or deeply fissured by recent tears, and its canal admits one or more fingers. The size of the uterus in normal conditions diminishes daily. The lochial discharges are found flowing from the cervix, and the placental site presents to the examining finger the nodular surface and fresh thrombi characteristic of recent delivery. The lochial discharges are distinguished from hemorrhage of non-puerperal origin by their microscopic constituents. When the importance of the question justifies it, conclusive evidence may sometimes be obtained by curetting the uterine cavity. The presence of decidual shreds or chorial villosities in the scrapings affords indubitable proof of recent pregnancy.

The length of time that has elapsed since confinement may during the first two weeks be estimated approximately by the condition of the breasts, the size of the uterus, and the character of the lochia. For the first two or three days the mammary secretion is colostrum; for several days subsequently the glands

are swollen and hard and milk is abundantly secreted. The fundus uteri is just above the umbilicus on the day following delivery, and it gradually sinks to the symphysis by the tenth. The changes in the lochia indicate roughly the progress of the puerperal period. The vulvar wounds are in a stage of repair proportionate to the number of days that have passed since the birth.

III. MANAGEMENT OF THE PUERPERIUM.

Posture.—During the first few hours after labor the best position for the patient is on the back. After the uterus has become permanently retracted and the vessels at the placental site are firmly closed by thrombi, the posture of the patient may be left to her own choice.

Rest.—A sound sleep of several hours after delivery is a favorable prognostic. It not only speaks well for the condition of the patient, but is a potent restorer. Care should be taken, therefore, to procure rest and sleep as soon as possible after the necessary attentions to mother and child have been completed. The room should be quiet, and the light be subdued by drawing the curtains. The use of hypnotic drugs is, if possible, to be avoided. It is especially important that the child be not permitted to disturb the mother's rest. It ought not to sleep in the same bed with the mother, and if it cries should be removed to another room.

Physician's Visits.—It is generally desirable that the first visit be made within twelve hours after confinement. This, however, is not always necessary when a competent graduate nurse is in charge. It is the duty of the physician to make a systematic examination of both mother and child at each visit. The principal points to be observed during the first days after delivery are—the general appearance of the woman, whether she has rested sufficiently; what and how much nourishment she has taken; the amount and character of the flow; whether the bladder has been emptied, and the quantity of urine passed; if the bowels move daily after the first twenty-four hours; the presence or absence of after-pains, and how severe they are. The pulse and temperature are to be noted. The binder should be loosened at each visit, and the uterus examined through the abdominal walls for the rate of involution as indicated by the height and width of the fundus; the degree of tenderness over the uterus and broad ligaments should be noted. It is especially important at the first visits to examine the suprapubic region by palpation to learn whether the bladder is distended. The urinary secretion is, as a rule, greatly increased during the first few hours after delivery. Injurious distention of the bladder frequently results. The assurance that the patient has passed water freely is not to be taken as proof that there is no retention. When overfilled the bladder may easily be made out as a fluid tumor between the uterus and the abdominal walls. Pressure with the hand over this region, too, will cause a desire to urinate. Marked fulness of the bladder frequently presents a visible

tumor above the pubes (Fig. 120). The condition of the breasts and nipples and the amount of milk secreted should be watched, especially during the first week.

Daily inquiry should be made with reference to the child—whether it nurses properly and shows signs of thriving; the condition of the eyes, mouth, skin, the stump of the navel cord, or the umbilical wound should be learned, and whether the bladder and bowels are properly evacuated. It is well for the first few days to know the rectal temperature. The nurse, if she is capable, will keep a systematic record of the foregoing and other facts for the doctor's inspection at his daily visits. Her observations are to be taken at stated hours two or three times during the day, and recorded on suitable blanks. This is particularly important during the first week. After that time if all is normal a simpler record will suffice.

After-pains, if severe enough to deprive the patient of sleep or to be exhausting, must be relieved. A grain or two of opium or an equivalent dose of morphin may be given, and be repeated once or twice subsequently if required. Since many women do not bear opium well, and as it is especially liable to injure the appetite and digestion, the object may usually be better accomplished by the use of chloral in doses of 20 or 30 grains. It may be given in water or in milk, by the mouth or by the rectum. The coal-tar analgesics are effective, but their repeated use is open to the objection that they lessen the strength of the uterine contractions and consequently retard involution. Little harm will be done when but one or two doses are required. Of these drugs, phenacetin, in doses of 5 grains, is to be preferred to acetanilid or to antipyrin, as it has a less depressant effect.

Asepsis.—Most important is a rigid cleanliness of the external genitals of the patient, her linen, and the bed-linen. The vulvar dressings should be changed every three to six hours during the first two or three days, and at all times as often as much soiled. Each time the dressing is renewed the external genitals and their immediate surroundings are to be cleansed with soap and water, and finally washed with an antiseptic solution. A convenient method of cleansing the vulva is by irrigation with a fountain syringe, the stream being projected against the parts to be cleaned and its action assisted by gentle friction with an aseptic cheese-cloth sponge. A bed-pan in position beneath the buttocks receives the washings.

If fetor is perceptible, it must be assumed, as a rule, that the toilet of the patient has not been properly cared for. If the passages have not been infected during the labor, external measures will be sufficient to keep the discharges sweet. Douching and all other interference within the passages are to be strictly avoided in normal cases. If the discharges become fetid notwithstanding proper external precautions, an antiseptic vaginal douche should be given two or three times daily or often enough to suppress all putrid odor. The approaches must first be rendered aseptic: the douche-tube, sterilized by boiling, is introduced for only 1 or 2 inches, with care to avoid abrading the mucous surfaces. Mercurials should not be used for the purpose, owing

to the danger of mercurial intoxication. A 15-volume solution of hydrogen dioxid, in full strength or diluted with three or four volumes of water, or Labarraque's solution in water (1 : 9), is suitable. It is unnecessary to say that other soiled portions of the body should be cleansed as often as soiled, and no blood-stained linen should be permitted to remain about the patient or the bed.

The lying-in woman perspires actively, hence her skin ought to be frequently cleansed by sponging with tepid water or with water and alcohol. This bath should be followed by gentle friction with a towel until a warm glow is produced. Cleanliness of the bed is promoted by the use of a draw-sheet, which consists of a common bed-sheet folded to four thicknesses. It is placed upon the bed beneath the patient's hips, and is changed as often as soiled.

Ventilation.—The atmosphere of the lying-in room must as nearly as possible be pure. Air should be admitted as freely by open windows as is consistent with a proper temperature of the apartment. As the air is constantly vitiated, so the ventilation, to be effective, must be continuous. Light is essential to the healthfulness and cheerfulness of the lying-in chamber. The practice of darkening the room, except when temporarily necessary to promote sleep, is irrational and has justly become obsolete. Even the full sunlight may be admitted, provided the child's eyes are properly protected. For the first few weeks the eyes of the new-born infant should be shielded from strong light from whatever source.

Diet.—The diet for the first twenty-four hours is to be restricted, as a rule, to liquids. In most cases even liquid food is to be withheld until the patient has had a few hours' rest. After the use of anesthetics no nourishment will be borne until she has recovered from the effect of the anesthetic. Exceptionally, when the labor has been an easy one without anesthesia, a little warm liquid nourishment, such as clear soup, bouillon, gruel, or cocoa and milk, may be allowed, if the patient requests it, directly after the close of labor. On the second day soft-boiled eggs, boiled custards, panadas, and similar easily-digested semi-solid foods are suitable. From this time on a moderately full diet is generally to be recommended. The dietary, however, must be varied to suit the needs of the individual case. As liberal a diet as the patient can digest is essential to the normal progress of convalescence and to the proper quantity and quality of the milk-secretion in nursing women.

Retention of Urine.—The enfeebled control over the bladder in the first hours after delivery frequently leads to retention of urine. This is especially liable to occur from the added effect of reflex disturbance when the perineum has been sutured. Owing to the copious secretion of urine, which is common at this time, painful and injurious distention of the bladder often results. Not only may serious injury thus be done to the bladder, but uterine hemorrhage after delivery is liable also to occur from over-distention of this viscus. The patient must be warned, therefore, of the importance of passing her urine within six or eight hours following the close of labor and at similar intervals thereafter. The difficulty of urination depends partly upon the recumbent position, and it may frequently be overcome, therefore, by allowing

the patient to assume a sitting or half-sitting posture during attempts at micturition. The sound of running water, warm fomentations over the meatus urethræ, and moderate pressure applied with the hand over the suprapubic region are useful aids, and are frequently effective even in the reclining position. The catheter should be withheld as a last resort, owing to the danger of setting up a more or less intense catarrh of the vesical neck from infectious material carried on the instrument. The mucosa of the lower portion of the bladder is liable to be bruised and fissured during labor, and its resisting power thereby impaired. In rare cases the ureters and the pelvis of the kidneys may be invaded by the septic process which frequently takes its origin from catheterization.

Use of the Catheter.—When catheterization is unavoidable, every precaution must be used to prevent infection of the bladder. The soft-rubber instrument, which is least liable to do mechanical violence to the vesical mucous membrane, is generally the most suitable catheter for use by the nurse. The Kelly or other glass catheter, which consists of a short glass tube with a foot or two of rubber tubing attached, has the advantage that it presents a perfectly smooth polished surface, and causes, therefore, a minimum amount of urethral irritation. Boiling in water for ten minutes immediately before using the instrument renders it aseptic. It is perhaps needless to say that after boiling the catheter is to be handled only with hands that have been rendered as nearly aseptic as possible.

The instrument must never be passed blindly by the sense of touch alone. With the patient in the dorsal recumbent position, the labia should be held well apart, either by the patient herself or by an assistant, so as to expose fully the meatus urethræ to view until the catheter is introduced. The vestibule and labia are then to be cleansed with soap and water, and washed with a suitable antiseptic. The catheter, well lubricated with vaselin previously sterilized by heat, is then passed—only far enough barely to enter the bladder—until the urine begins to flow. Care should be taken on withdrawing the instrument that no urine be permitted to trickle into the vagina or over the vulvar wounds. If the parts accidentally become soiled, they should be cleansed by pressing them with a clean damp cloth. The catheter is to be washed carefully with soap and water and rinsed with clear water after using. The bladder should be emptied at the same intervals as in voluntary urination.

Evacuation of the Bowels.—It is a long-established custom to open the bowels on the third day. The most suitable measure is a mild saline laxative. An eligible saline for the purpose is the solution of citrate of magnesium (liquor magnesii citratis). The action of the bowels may, if necessary, be assisted by a rectal injection of warm water or of sweet oil. Useful stimulating enemata, if required, are salt water, soap and water, a drachm or two of undiluted glycerin, or one or two ounces of a saturated solution of Epsom salt. The bowels should be opened daily after the first day.

Lactation.—In the interests of both herself and her infant the mother

ought, as a rule, to nurse her own child. In certain conditions, however, this may be inadvisable or even impossible. Syphilis contracted late in pregnancy and tuberculosis are contra-indications to maternal nursing, owing to the danger of infecting the child. Rarely, suckling may be impracticable by reason of inversion of the nipples, or may have to be discontinued in consequence of excoriation and persistent sensitiveness of these organs. Sometimes the mother's milk is deficient in quality or in quantity. In marked general debility from whatever cause nursing would be injurious to both mother and child.

The early application of the child to the breast promotes the uterine contractions: it is particularly advisable when the uterus remains relaxed after labor. As a rule, the child is put to the breast only after the mother has rested, after six or eight hours. It should be nursed once in four hours during the first few days until the mammary function is established. Usually the child will thus have learned to nurse before the onset of the true milk-secretion, and the danger of painful engorgement of the breasts will be diminished. Regularity in nursing is as essential to the interests of the mother as to those of the child. The nipple is injured by prolonged and frequent maceration. The milk becomes concentrated by over-frequent suckling, thin and dilute when the intervals are too prolonged. For this reason the child should not be permitted to sleep in the same bed with its mother: it should lie in a crib by itself. The healthy condition of the nipples will be promoted by carefully cleansing and drying them after the child has nursed. A saturated solution of boric acid is a simple and effective lotion for the purpose. If they are disposed to crack, it is useful to anoint the nipples with fresh cacao-butter after cleansing. During the first few days of lactation the breasts frequently become painfully swollen. Painful induration of the glands in the absence of inflammation is relieved by gentle massage, stroking the breasts outward from the base toward the nipple. This manipulation is best practised immediately before putting the child to the breast. Distention from over-free secretion is relieved by saline cathartics, by abstention from liquids, and by the use of a compression breast-bandage. An easily improvised binder is the Murphy binder. It is made of a straight piece of muslin, with a shallow notch cut in one edge for the neck and a deep notch for each arm (Fig. 121). The bandage is closely applied over the breasts, the ends being pinned in front (Pl. 27, Fig. 2).

Not infrequently, especially in debilitated women, the supply of milk is insufficient. The most reliable evidence of defective lactation is afforded by the signs of inanition in the child. If the infant ceases to gain in weight or if the weekly gain falls short of the normal, in the absence of disease it is to be assumed that the quantity or the quality of the mother's milk is at fault. In many cases it is possible to do something to improve the character and to increase the quantity of the breast-milk by attention to hygienic measures. The best galactagogues are tonics, a generous diet, including the use of milk, and attention to the habits and hygienic surroundings of the mother. Precautions must be taken, however, against over-feeding and consequent derange-

ment of the digestive organs. The daily application of a mild faradic current through the breasts, it is claimed, acts to stimulate the mammary functions. In the writer's experience the sulphate of strychnin in doses of from $\frac{1}{40}$ to $\frac{1}{30}$ of a grain, three times daily, has apparently done good service, probably more by its general tonic effect than by any specific influence. Somatose is useful. Three or four teaspoonfuls are given daily in bouillon, cocoa, or milk. Most foods containing phosphorus are believed to increase the quantity of the secretion. Thyroid extract administered in doses of one grain from three to five times daily affects favorably both the quantity and the quality of the milk. Excellent results have been reported from the use of a new galactagogue sold under the commercial name roborat. From 30 gm. to 80 gm. may be given daily in milk, cocoa, chocolate, or in soup.

When, owing to the death of the child or for other reasons, it becomes necessary to dry up the milk, a purely expectant treatment usually answers. The patient, however, generally suffers more or less pain in the breasts for two or three days. Her comfort is promoted and the disappearance of lactation is more rapid with the use of the compression binder. Daily applications of the oleate of atropia are of great value for the relief of pain and for their specific effect in drying up the secretions. Restrictions of liquids and the use of a saline cathartic also help. The iodid of potassium in 15-grain doses repeated two or three times daily exercises a decided influence in diminishing the flow of milk.

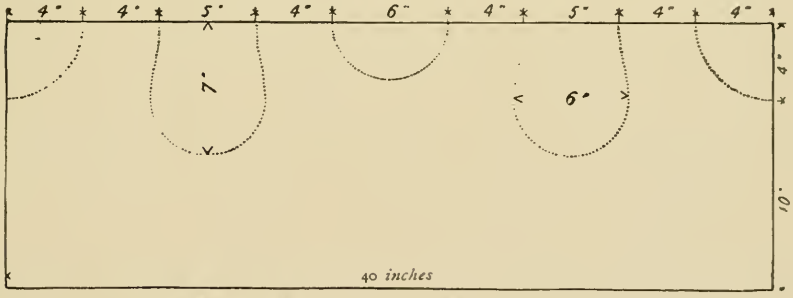


FIG. 121.—Modified Murphy breast-binder (cut on the dotted lines).

Tardy Involution.—When in the daily examination of the uterus it is found that involution is not progressing normally, measures should be used to accelerate the process. Friction applied two or three times daily is useful for this purpose. The nurse lays the hand flat upon the abdomen over the uterus, and moves the abdominal walls in a circular direction over the anterior surface of the uterus, precisely as is done for stimulating uterine contractions in the third stage of labor. This procedure should be conducted gently, so as to give no pain, and it may be continued for ten minutes at each sitting. Faradism or galvanism is useful for hastening involution. A mild faradic current may be used ten or fifteen minutes daily, or a smooth galvanic current of ten to twenty milliampères may be employed for the same length of time. One electrode is placed over the upper part of the sacrum and the other on the abdomen over the uterus. A hot vaginal douche once or twice daily is

an agent of value for promoting involution. The temperature of the water should be about 115° F., and the quantity used not less than two or three gallons. Ergot in doses of a grain of the solid extract or its equivalent three times daily may be given with benefit. Sometimes the cause of the retarded involution is a septic condition of the endometrium. The remedy in such cases is a thorough curetting of the uterine cavity.

Special Directions.—Few women, particularly of the better classes, approach labor in the full vigor of health. The pressure-effects of the later weeks of pregnancy, the impaired nutrition, the loss of exercise, and the mental anxiety which are common at this period, all conduce to enfeeble the physical powers. When to these conditions are added the exhausting effects of labor, it is not surprising that childbirth is frequently followed by more or less debility, even in the absence of complications. Restorative measures, therefore, usually constitute an important part of the management of convalescence. The necessity for plenty of sleep and a proper diet has already been alluded to. In addition to this the use of tonics is often of signal service. In anemia one of the proto-salts of iron may be given for several weeks. The Blaud pill is a popular and valuable hematinic. The arsenate of iron is especially efficacious in the treatment of anemia in puerperal women. Attention should be paid to the condition of the digestive organs, and the amount and character of the patient's food should be regulated. If the appetite is poor, a bitter tonic may be prescribed. An eligible mixture for the purpose is the elixir of calisaya with strychnin; ʒij of the former and gr. $\frac{1}{40}$ of the latter may be given three times daily. A good general tonic is citrate of iron and quinin with strychnin or nux vomica. A drachm of the double citrate with a grain of strychnin may be prescribed in a four-ounce mixture, with directions to take a teaspoonful three times a day; or 2 grains of the citrate with one-third grain of extractum nucis vomicæ may be administered in pill form with the same frequency.

Special attention should be given to the condition of the pelvic organs during the post-partum month. For the first ten days the daily examination of the uterus by the abdominal touch will enable the physician to observe the progress of involution. After that time the position and size of the uterus cannot readily be determined by abdominal examination. It is generally advisable, even in private practice, to make a bimanual examination during the third or fourth week with special reference to the shape and position of the uterus. In hospitals it is the rule to explore the pelvic contents shortly before the patient's discharge. If the uterus be retroverted, it should be reposited, and be held in place by a suitable pessary. Often persistent retroversion may thus be prevented. The pessary may be disused after two or three months. Undue persistence of the red flow or an abnormally open cervix is generally to be taken as evidence of endometritis. Most effectual for the treatment of this condition is a curettage. This procedure should be conducted with strict aseptic precautions.

Regulation of the Lying-in.—The length of time which it is desirable that

the woman should be kept at rest after labor will obviously vary with the rate of uterine involution and with the general progress of convalescence. During the first week she ought not to leave her bed. Ordinarily she may be allowed to rise partly or fully into a sitting posture during micturition. This often obviates the necessity for using the catheter in patients who have difficulty in passing water in the reclining posture. It also favors the expulsion of vaginal blood-clots, and after the first six or eight hours does not, as some writers have asserted, expose the patient to displacement of thrombi or to hemorrhage. Throughout the second week the patient should maintain for the most part the recumbent position, though she need not be confined to bed. She may for a part of the day be removed to a lounge or may lie upon the outside of the bed, and may sit erect when taking her meals. During the third week a large portion of each day may be spent in a chair. The patient, however, should not, as a rule, be allowed on her feet. In the fourth week she can have the liberty of the room, and at the end of the puerperal month, if all goes well, may be permitted to leave her room. It is advisable, however, that she should not fully resume her usual duties for two or three weeks.

Care of the New-born Infant.

Immediately after birth of the head the child's face should, when opportunity permits, be bathed with warm water, the eyes cleansed and carefully dried. This is done as a prophylactic against ophthalmia. As a still further preventive, within an hour after birth a drop of Credé's solution (a 2 per cent. solution of nitrate of silver) should be instilled into the conjunctival sacs of each eye. The latter precaution, when properly executed, is absolutely protective. No permanent injury is done to the delicate structures, and the serous oozing which frequently results subsides within a few days. Should it be excessive, it may be promptly controlled by a single application of a drop or two of a $\frac{1}{2}$ per cent. solution of the sulphate of atropin. In the writer's practice Credé's solution has been replaced by protargol. A strength of fifty grains to the ounce of distilled water is employed. Yet a weaker solution, twenty grains to the ounce, appears to be effective. The protargol solution causes little or no pain or irritation and is apparently more effective, either as a prophylactic or remedial measure, than the nitrate of silver solution.

The ligation of the funis and the dressing of the stump have already been considered. Usually respiration is promptly established at birth, partly by the air-hunger developed by interruption of the utero-placental circulation, and partly by the reflex effect of the contact of cool air with the moist surfaces of the body. When the new-born infant does not breathe properly soon after birth, means should be employed to secure the full expansion of the lungs. Useful measures for this purpose are blowing forcibly upon the face, dashing a few drops of cold water upon the chest or the face, or gently slapping the buttocks with the hand or with the end of a wet towel. These efforts should be continued until the child cries lustily. When respiration is obstructed

equally. The outfit described below is a simple and suitable method of dress for the first six months.

The belly-band, which should be of the lightest material, is to be discarded after the umbilical wound has healed. It is used merely for the retention of the navel dressing, and it serves no useful purpose after the navel has healed. It is a mistake to suppose that a tight abdominal bandage helps to prevent umbilical protrusion. On the contrary, by increasing the intra-abdominal pressure, it has the opposite effect. The belly-binder, therefore, like the rest of the child's clothing, ought to be loose enough to admit easily two or three fingers underneath it.

The customary triangular napkin may be of muslin or of linen diaper. A single safety-pin here is all that need be used in the clothing. Napkin-covers of rubber, which are obviously unsanitary, should never be tolerated.

The clothing proper consists of an undershirt and two dresses. The undershirt should be made of the softest flannel, without sleeves and opening in front. Next is a fine flannel dress with high neck and long sleeves, cut *à la princesse*, and about 25 inches in length; this, too, opens in front. Over all is a muslin slip of a pattern similar to the flannel dress. The feet and legs are to be protected with woolen socks reaching to the knees. The undershirt and dresses may be fastened with tapes. All clothing should be laundered before using, and should be changed daily. At night the muslin and flannel slips may be replaced by a suitable night-dress. The weight of these garments is to be adjusted to the requirements of the season.

Nursing.—As a rule, when the mother's nipples are of normal size and well formed the fully-developed and healthy child instinctively suckles when first placed to the breast. Not infrequently the new-born infant does not take the nipple willingly, particularly if the nipples are small or misshapen or the child is puny or feeble. Much trouble may be saved by teaching the child to nurse before the breasts become engorged. Patience and tact will usually ensure success. Wetting the nipple with a few drops of milk squeezed from the breast, or with a little sugar and water, before applying the child may be tried if necessary to induce it to nurse.

The infant should be put to the breast as soon as the mother has rested, usually within six or eight hours after birth, and should nurse once in four hours until the milk-secretion is established. Subsequently the average interval is once in two hours. The intervals should be lengthened, as a rule, to three hours by the end of the third month, and thus continued until the sixth. About six hours should be allowed, however, between the last nursing at night and the first in the morning. From ten to twenty minutes is enough for each nursing. As the child usually falls asleep easily after its meal, it is well, if necessary, to wake it on the hour. Regularity of feeding is of the utmost importance in the interest of good digestion and proper nutrition, and the habit should be established early. It is generally best to apply the child to both breasts at each nursing.

Regurgitation of food soon after feeding is usually to be taken as evidence

that the stomach is overfilled. For the first two or three days after birth the child gets but little nourishment from the breasts, but it needs little. Should it become restless and fretful from hunger during this time, an occasional teaspoonful of plain water, previously boiled, will often serve to quiet its cravings. Whey may be given in quantities amounting to five or ten ounces daily, but a child that is fed does not so readily take the breast, and hand-feeding is therefore not, as a rule, advisable if the child is to be nursed.

The best evidence of proper nutrition is a progressive gain in weight. It is a good practice to weigh the child weekly. A loss of several ounces usually takes place during the first few days after birth, and the child does well if at the end of the week it has regained its birth-weight. After the first week, in normal conditions, its weekly gain for the first five months should not fall below five ounces.

Wet-nursing.—When for any reason maternal nursing fails or must be discontinued, the best substitute for the mother's breast is that of a suitable wet-nurse. The greatest care must be exercised in her selection. The best age is between twenty and thirty-five years. A multipara, or at least a woman who has had some experience in nursing, is to be preferred. It is desirable that the nurse's child be of about the same age as that to be nursed. A difference of a month, however, is unimportant, especially if the foster-child be the younger. A menstruating woman is sometimes undesirable, particularly if the flow be prolonged or be copious. Her breasts should be well formed, and should promptly refill after nursing. The nipples should be sound and be well developed. Women whose breasts are of a conical shape and not too large usually make the best nurses.

The best evidence of the amount and quality of the nurse's milk is to be found in the way her own child thrives. In case of doubt a chemical examination of the milk may be made. It is unnecessary to say that sound health is indispensable. In addition to the direct examination, useful information may be gained on this point by consulting the physician who attended the woman in her confinement. Any serious impairment of her general health will usually disqualify—tuberculosis or syphilis always. Even after she is established in her new office her health and habits must be looked to and the child be watched to see that it thrives.

Artificial Feeding.—While there is still no substitute which fully equals the natural food of the new-born infant, the best modern methods of artificial feeding leave little to be desired. Yet success is possible only by the constant exercise of much care and skill in the management of the feeding, especially in the adaptation of the substitute food to the needs of the individual case.

Most essential in a substitute food is a close approximation to breast milk:

1. In chemical and physical properties.

2. In freedom from bacterial organisms and the effects and products of bacterial life.

The one condition is fulfilled approximately by the modification of cow's

milk, the other is best secured by a rigorous supervision of the primal milk supply, supplemented, if need be, by Pasteurization.

Chemical and Physical Properties.—Average human milk contains from 1 to 2 per cent. of proteids, from 3 to 4 per cent. of fat, and from 6 to 7 per cent. of sugar. In cow's milk the percentage of each of these ingredients is, in round numbers, 4 per cent. Mere dilution of cow's milk, therefore, does not afford a proper food. Fortunately, in the top 10 ounces from a quart bottleful on which the cream has risen the ratio of fat to proteids is substantially the same as in human milk of the early months of lactation, about 3 : 1. Hence, a 10-ounce top-milk diluted three to seven times yields a product closely resembling the natural food of the new-born infant, with the exception that it is deficient in sugar. This defect is corrected by adding one ounce of milk-sugar for each 20 or 30 ounces of food. As the child develops the proportions of fats and proteids are gradually made more nearly equal by taking from month to month a larger number of ounces from the top of the bottleful. The bottled milk commonly supplied in cities has usually creamed when delivered. The cream constitutes approximately the top 6 ounces in the bottle, and the line of demarcation between cream and undermilk is plainly visible. When milk can be had fresh from the cow, it may safely be assumed that after standing four hours on ice nearly all the cream will be contained in the top third.

Human milk is neutral or slightly alkaline in reaction, while cow's milk is usually acid. The addition of 4 or 5 per cent. of lime-water to neutralize the acidity of the substitute food is generally advisable.

Owing to the relative deficiency of sodium salts in cow's milk, about 8 grains of common salt may be added to advantage to each pint of the food.

The casein of cow's milk is not so digestible as that of human milk. It tends to coagulate in tenacious masses in the child's stomach, while breast-milk yields a light, flocculent curd. This defect is partially overcome by dilution with water. A more effectual diluent for the purpose is a thin gruel made with oat, barley, wheat, or rice flour.

An even tablespoonful of the flour is mixed to a thin paste with cold water. This is stirred into a pint of hot water and boiled twenty minutes. While the ability to digest starch is not wholly lacking, even in the new-born child, it is best in most instances, especially in very young infants or in those of feeble digestion, to dextrinize the starch.

The cereal may be dextrinized by the use of diastase. A solution of diastase is prepared by covering a tablespoonful of malted barley grains, crushed, with two tablespoonfuls of cold water and allowing it to stand in a refrigerator over night. The infusion is then strained off. A tablespoonful of this solution dextrinizes a pint of gruel in fifteen minutes. A tablespoonful of Forbes' diastase or of Cereo may more conveniently be employed. After straining, the gruel is ready for use.*

* The writer is indebted for many valuable suggestions in this article to the recent writings of Dr. Henry Dwight Chapin.

It has been found that the non-nitrogenous admixture has a further advantage in that it lessens nitrogenous elimination and thus adds to the nutritive value of the proteids. It also retards the putrefaction of the proteids in the digestive tract.

Bacteria.—Not less essential is it that the substitute shall resemble the natural food in freedom from disease-producing bacteria and the germs of fermentation than in its physiological properties. Complete sterilization is possible by the use of heat. But exposure to high temperatures injures the nutrient properties of the milk in proportion to the extent and duration of the heating. At a temperature of 212° F. the albumin is coagulated, the nuclein and the lecithin are destroyed, and other injurious changes are produced.

Pasteurizing or heating to 170° F. for twenty minutes is less objectionable.

Heating to 150° F. for the same length of time works a minimum of injury, and it is sufficient to kill nearly 99 per cent. of the bacteria if the milk is stirred gently during the heating.

As a rule, better results are possible by extreme care in collecting and handling the milk than by any process of sterilization. There is no satisfactory method of remedying the evils of uncleanliness.

Mixed dairy milk is better than that of one cow, since it is subject to less variation in quality. The cows must be healthy. The stable should be clean, properly ventilated, and the animals well groomed. Most essential are cleanly methods of milking. Before milking, the hands of the milkman and the cow's udder should be cleansed carefully. The first few jets of milk are better rejected. The vessel in which the milk is received and the cans or bottles in which it is packed for delivery must be as nearly sterile as practicable. The immediate abstraction of the animal heat by promptly chilling to a temperature of 50° F. or lower is important, since bacterial organisms grow rapidly at or near the body-temperature.

If these precautions are rigidly observed and the milk is kept at a temperature constantly below 50° F., it will undergo little injurious change for several days.

The following table affords a plan of infant feeding requiring only the simplest possible mathematical computations:

Simple Plan for Feeding a Healthy Infant During the First Year.

1st week	10-oz.	top-milk,	1½	oz.;	Dextrinized gruel,	9 or 10	oz.;	Milk-sugar,	½ oz.
End 1st month,	11-oz.	"	4	oz.;	"	"	12 oz.;	"	¾ oz.
" 3d "	12-oz.	"	15	oz.;	"	"	30 oz.;	"	2 oz.
" 6th "	16-oz.	"	24	oz.;	"	"	24 oz.;	"	2 oz.
9 to 12th "	20-oz.	"	32	oz.;	"	"	16 oz.;	"	1¾ oz.

It may generally be assumed that 10-ounce top-milk from a quart bottleful of medium grade on which the cream has fully risen is a milk of 12 per cent. fat-strength; that the fat-strength of 12-ounce top-milk is about 10 per cent.; of 16-ounce top-milk, 8 per cent.; and of 20-ounce top-milk,

milk, the other is best secured by a rigorous supervision of the primal milk supply, supplemented, if need be, by Pasteurization.

Chemical and Physical Properties.—Average human milk contains from 1 to 2 per cent. of proteids, from 3 to 4 per cent. of fat, and from 6 to 7 per cent. of sugar. In cow's milk the percentage of each of these ingredients is, in round numbers, 4 per cent. Mere dilution of cow's milk, therefore, does not afford a proper food. Fortunately, in the top 10 ounces from a quart bottleful on which the cream has risen the ratio of fat to proteids is substantially the same as in human milk of the early months of lactation, about 3 : 1. Hence, a 10-ounce top-milk diluted three to seven times yields a product closely resembling the natural food of the new-born infant, with the exception that it is deficient in sugar. This defect is corrected by adding one ounce of milk-sugar for each 20 or 30 ounces of food. As the child develops the proportions of fats and proteids are gradually made more nearly equal by taking from month to month a larger number of ounces from the top of the bottleful. The bottled milk commonly supplied in cities has usually creamed when delivered. The cream constitutes approximately the top 6 ounces in the bottle, and the line of demarcation between cream and undermilk is plainly visible. When milk can be had fresh from the cow, it may safely be assumed that after standing four hours on ice nearly all the cream will be contained in the top third.

Human milk is neutral or slightly alkaline in reaction, while cow's milk is usually acid. The addition of 4 or 5 per cent. of lime-water to neutralize the acidity of the substitute food is generally advisable.

Owing to the relative deficiency of sodium salts in cow's milk, about 8 grains of common salt may be added to advantage to each pint of the food.

The casein of cow's milk is not so digestible as that of human milk. It tends to coagulate in tenacious masses in the child's stomach, while breast-milk yields a light, flocculent curd. This defect is partially overcome by dilution with water. A more effectual diluent for the purpose is a thin gruel made with oat, barley, wheat, or rice flour.

An even tablespoonful of the flour is mixed to a thin paste with cold water. This is stirred into a pint of hot water and boiled twenty minutes. While the ability to digest starch is not wholly lacking, even in the new-born child, it is best in most instances, especially in very young infants or in those of feeble digestion, to dextrinize the starch.

The cereal may be dextrinized by the use of diastase. A solution of diastase is prepared by covering a tablespoonful of malted barley grains, crushed, with two tablespoonfuls of cold water and allowing it to stand in a refrigerator over night. The infusion is then strained off. A tablespoonful of this solution dextrinizes a pint of gruel in fifteen minutes. A tablespoonful of Forbes' diastase or of Cereo may more conveniently be employed. After straining, the gruel is ready for use.*

* The writer is indebted for many valuable suggestions in this article to the recent writings of Dr. Henry Dwight Chapin.

It has been found that the non-nitrogenous admixture has a further advantage in that it lessens nitrogenous elimination and thus adds to the nutritive value of the proteids. It also retards the putrefaction of the proteids in the digestive tract.

Bacteria.—Not less essential is it that the substitute shall resemble the natural food in freedom from disease-producing bacteria and the germs of fermentation than in its physiological properties. Complete sterilization is possible by the use of heat. But exposure to high temperatures injures the nutrient properties of the milk in proportion to the extent and duration of the heating. At a temperature of 212° F. the albumin is coagulated, the nuclein and the lecithin are destroyed, and other injurious changes are produced.

Pasteurizing or heating to 170° F. for twenty minutes is less objectionable.

Heating to 150° F. for the same length of time works a minimum of injury, and it is sufficient to kill nearly 99 per cent. of the bacteria if the milk is stirred gently during the heating.

As a rule, better results are possible by extreme care in collecting and handling the milk than by any process of sterilization. There is no satisfactory method of remedying the evils of uncleanliness.

Mixed dairy milk is better than that of one cow, since it is subject to less variation in quality. The cows must be healthy. The stable should be clean, properly ventilated, and the animals well groomed. Most essential are cleanly methods of milking. Before milking, the hands of the milkman and the cow's udder should be cleansed carefully. The first few jets of milk are better rejected. The vessel in which the milk is received and the cans or bottles in which it is packed for delivery must be as nearly sterile as practicable. The immediate abstraction of the animal heat by promptly chilling to a temperature of 50° F. or lower is important, since bacterial organisms grow rapidly at or near the body-temperature.

If these precautions are rigidly observed and the milk is kept at a temperature constantly below 50° F., it will undergo little injurious change for several days.

The following table affords a plan of infant feeding requiring only the simplest possible mathematical computations:

SIMPLE PLAN FOR FEEDING A HEALTHY INFANT DURING THE FIRST YEAR.

1st week	10-oz.	top-milk,	1½ oz.;	Dextrinized gruel,	9 or 10 oz.;	Milk-sugar,	½ oz.
End 1st month,	11-oz.	"	4 oz.;	"	"	12 oz.;	"	¾ oz.
" 3d "	12-oz.	"	15 oz.;	"	"	30 oz.;	"	2 oz.
" 6th "	16-oz.	"	24 oz.;	"	"	24 oz.;	"	2 oz.
9 to 12th "	20-oz.	"	32 oz.;	"	"	16 oz.;	"	1¾ oz.

It may generally be assumed that 10-ounce top-milk from a quart bottleful of medium grade on which the cream has fully risen is a milk of 12 per cent. fat-strength; that the fat-strength of 12-ounce top-milk is about 10 per cent.; of 16-ounce top-milk, 8 per cent.; and of 20-ounce top-milk,

6 per cent.; the percentage of proteids in all is approximately 4 per cent., and that of milk-sugar 4 to 5 per cent.

The top-milk is removed from the under-milk by ladling or by decanting, or the under-milk may be siphoned off. Most convenient for domestic use is the method recommended by Chapin. The desired number of fluid-ounces of top-milk are removed from the bottle by means of an ounce dipper provided with a long handle, as shown in Fig. 122. This is lowered carefully into the bottle until filled, and is then lifted out and emptied. The process is repeated until a cream of the required fat-strength is obtained. The first ounce, however, must be taken off with a teaspoon, otherwise a part of the top layer of cream in the bottle would be lost by overflowing as the dipper is immersed.

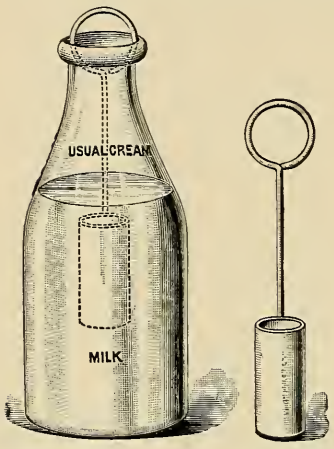


FIG. 122.—Chapin's dipper and the method of using it.

The strength of the food depends on the dilution. It is best to begin with a weak food and work up as rapidly as the child's digestion may permit. The ratio of fat to proteids is regulated by the number of ounces of top-milk used in preparing the mixture. In other words, the fat-strength of the top-milk will vary in inverse ratio to the number of ounces taken from the top of the bottleful, provided the entire cream layer is included in the top-milk. Exceptionally the use of plain water as a diluent may be found to agree better than the cereal.

The amount and frequency of feeding are as stated in the table on page 185. Changes in the formulas and in the amount and frequency of feeding should be gradual.

A teaspoonful of lime-water for each 4 ounces of food may be added just before feeding. Eight grains of salt to each pint of food is a useful addition.

Milk Laboratories.—For several years milk laboratories for the modification of cow's milk for infant feeding have been in successful operation in the principal cities of the Union. The milk is obtained from selected animals with special care in collecting and handling, and is delivered at the laboratory within a few hours after milking. Milk mixtures are compounded on the physician's prescriptions with the proportions of proteids, fat, and sugar to suit the needs of individual cases.

Generally the ingredient which requires most attention in prescribing is the proteids. Any considerable departure from the standard percentages of fat and of sugar are less frequently necessary. Yet the proportion of proteids should be kept up to the full capacity of the infant's digestion. In cases of feeble fat-digestion the fat-strength of the food must temporarily be reduced. The milk-sugar is usually well borne in nearly or quite the full percentage from birth.

The following table compiled from different sources may serve for general guidance in writing food prescriptions for a healthy infant. Yet some variation in the quantity and frequency of feeding and in the percentages of the food ingredients is not only permissible, but in individual cases is often demanded.

SCHEME FOR PERCENTAGE FEEDING DURING THE FIRST YEAR.

	Quantity at Each Feeding.	Proteids.	Fat.	Sugar.	Lime-Water.	Number of Daily Feedings.
1st week	1 ounce	0.50	1.50	5.00	5.00	10
2d "	1½ ounces	0.75	2.00	5.00	5.00	10
3d "	2 "	1.00	2.50	6.00	5.00	10
4th to 6th week	2½ to 3 ounces	1.00	3.00	6.00	5.00	10
6th to 8th "	3 to 3½ "	1.00	3.50	6.50	5.00	10
8th to 16th "	3½ to 4½ "	1.50	3.50	6.50	5.00	8 or 9
16th to 24th "	4½ to 5¾ "	1.50	4.00	7.00	5.00	7
24th to 32d "	5¾ to 7 "	2.00	4.00	7.00	5.00	6
32d to 34th "	7 "	2.00	4.00	7.00	5.00	6
34th to 36th "	7½ "	2.25	4.00	7.00	5.00	6
36th to 40th "	7 to 8 "	2.50	4.00	6.50	5.00	6
40th to 44th "	8 to 8½ "	3.00	4.00	5.00	5.00	5
44th to 48th "	8½ "	3.50	4.00	4.50	5.00	5
48th to 52d "	9 "	4.00	4.00	4.50	5.00	5

The percentages of proteids, fats, and sugar to be prescribed in an average case are indicated by the foregoing figures. These percentages are modified to meet special requirements. Failures of digestion and the kind of failure are indicated by the usual signs of indigestion—flatulence, colic, vomiting, inanition, and the character of the stools. Undigested curds in the stools call for reduction in the strength of the food. Vomiting rancid curds is an indication for reducing the percentage of fat. Looseness of the bowels may be due to excess either of fat or of sugar.

Such slight variations in the proportions given as may be necessary to meet individual requirements must be determined by watching the digestion and nutrition of the child.

Percentage Feeding in Domestic Practice.—Laboratory methods are not available for all, and fortunately percentage feeding is easily possible without them. The various ingenious formulas which have been devised for computing the proportions of the different food ingredients are also unnecessary. Sufficient accuracy for practical purposes is possible by the following simple method of computation: The principal working materials are boiled water or dextrinized gruel, purified milk-sugar, and top-milk of known fat-percentage. The top-milk is taken from a quart bottleful of milk which has fully creamed or stood on ice for at least four hours. The percentage of proteids and of sugar, it may be assumed, is not disturbed by the creaming process; it is substantially the same in the top-milk and in the under-milk as before the cream had risen. The fat-strength of the top-milk, on the other hand, obviously will vary with the number of ounces taken from the top of the bottle. If the whole milk contains 4 per cent. of fat, the top half of the bottleful, on which the cream has fully risen, will contain approx-

imately twice as much, or 8 per cent.; the top third, three times as much, or 12 per cent.; the top fourth, four times as much, or 16 per cent. The fat-strength of the top two-thirds would be 6 per cent. ($4 \times 3 = 12$, $12 \div 2 = 6$); of the top three-fourths, $5\frac{1}{3}$ per cent. ($4 \times 4 = 16$, $16 \div 3 = 5\frac{1}{3}$), and so on. The percentage of proteids and of sugar in the diluted milk will vary directly with the degree of dilution. The quantity of the milk-sugar which must be added to bring the percentage of this ingredient up to the required standard is readily computed. If the diluted milk contains 2 per cent. of sugar, the quantity of sugar that must be added to raise the sugar to 7 per cent. will be 5 per cent. of the total number of ounces of food. Thus a mixture consisting of 10 ounces of 16-ounce top-milk and 10 ounces of diluent will contain approximately 2 per cent. of proteids, 4 per cent. of fat, and 2 per cent. of sugar. The addition of 1 ounce of milk-sugar ($20 \times 0.05 = 1$) will raise the sugar percentage to 7. Slight inaccuracies in the computation will arise from inevitable variations in the quality of the milk, but these variations are no greater than obtain in human milk, and are usually unimportant. The final adjustment of the percentages must be determined by watching the infant's digestion and the weekly gain in weight.

Whey and Whey Mixtures.—In feeble digestion the writer has frequently made use of whey with satisfaction. Whey contains of proteids 0.8 per cent., of fat 0.23 per cent., and of sugar 4.75 per cent. If the curd is thoroughly broken up by stirring before straining, the resulting whey contains of proteids, 0.98 per cent., of fat, 2 per cent., and of sugar, 4.75 per cent. Whey therefore affords a food of fair nutritive strength, and it is usually well borne even by puny infants. Its nutrient value, moreover, may be increased at will by adding beaten white of egg,* 10- or 16-ounce top-milk, and milk-sugar.

Whey is prepared as follows: The milk is heated, best in a double boiler, to 115° F. One or two teaspoonfuls of Fairchild's essence of pepsin are then added. It is kept at the same temperature for about ten minutes, when it will be found completely curdled. It is then heated to 140° F. to kill the ferment, and is strained through cheese-cloth or a wire strainer.

The following whey and cream mixture very closely resembles human milk:

Whey and Cream Mixture.

Eight-ounce top-milk,	8 ounces;
Whey,	24 "
Milk-sugar,	$1\frac{1}{4}$ "

Dr. Bartley recommends the following formula for healthy infants:

Bartley's Formula.—From the bottom of a bottle of fresh milk of good quality which has stood for three hours he siphons off three-fourths of its contents, leaving the cream and upper part of the milk undisturbed in the

* White of egg contains approximately 12 per cent. of proteids. The remaining 88 per cent. is nearly all water.

bottle. This may be done with a piece of small rubber tubing previously filled with water to start the siphonage. One end of the rubber tube is held firmly while the other is thrust through the cream and to the bottom of the bottle. The outer end is lowered into the inner vessel of an ordinary double boiler and released, when the skim milk will run out, provided the latter vessel is kept lower than the milk in the bottle. The whey is prepared from the milk thus drawn off. It is sweetened, and when cold is poured back into the milk bottle and mixed thoroughly with the top-milk. Should this food prove too laxative, the quantity of milk-sugar may be reduced. From 4 to 5 per cent. of lime-water should be added. As the child increases in age and strength the amount of under-milk siphoned off may be diminished.

Bottling and Feeding.—Enough of the modified milk for the day's use is distributed in nursing-bottles, each holding the quantity required for a single feeding. The bottles must have been fully sterilized immediately before filling. They are stoppered with sterile cotton plugs or rubber stoppers. If the food is to be Pasteurized, the bottles are loosely stoppered at first, and the stoppers pushed in tightly after heating. The food is fed at a temperature of 100° F., and directly from the bottle, the stopper having been replaced by an aseptic rubber nipple, slipped over the neck of the bottle. The mother or nurse before preparing the food and before handling the stoppers or nipples should cleanse the hands carefully with soap and water.

IV. PATHOLOGY OF THE PUERPERIUM.*

I. Injuries to the External Genital Organs following Labor.

The dilatation of the parturient canal and the expulsion of the fetus and the placenta are almost always associated with more or less injury to the maternal tissues.

These injuries are usually in direct proportion to the resistance which the parts in question offer to the passage of the fetus. They are therefore, as a rule, greatest in primiparæ, and they may be absent in women that have repeatedly given birth. They are smallest in natural confinements—that is, in cases in which the forces of nature are sufficient to effect safe expulsion of the fetus in the proper time and manner—and they are greatest when a mechanical disproportion between the fetal parts and the parts of the mother, or a malposition of the fetus, or any of the numerous complications of labor, endangers either the mother or the child, and calls for operative interference (instrumental or manual) on the part of the obstetrician. They are likely to be especially great when

* The *superior* figures ([1]) occurring throughout the text of this section refer to the bibliography given on page 330.

this operative interference becomes imperative at a time when the parturient canal is only incompletely dilated.

The most common of these injuries consist in contusions and tears of the vulva, the perineum, the vagina, and the neck of the uterus; some of the rarer accidents, such as lacerations of the body of the womb, inversion of the uterus, and injuries to the pelvic bones, have been described under *Dystocia.*

Injuries to the Vulva.—At times we find transverse lacerations of the vulva that involve the deeper tissues, perforating the nymphæ and leaving them fenestrated for the rest of the patient's life, or going completely through either labia minora or majora or both, and causing these structures to hang in shreds. The most frequent accident to the vulva, however, consists in tears

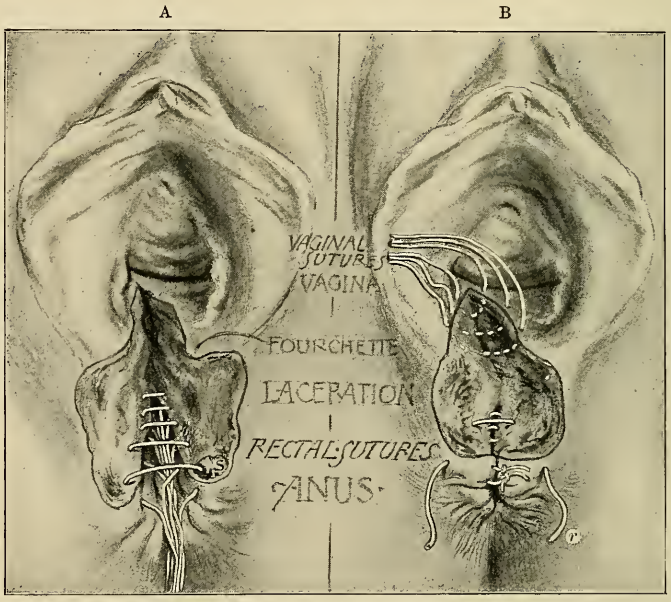


FIG. 123.—Perineal lacerations: A, laceration extending through the sphincter (*s*) into the rectum, stitches introduced through torn margins of rectum and through ends of sphincter (*s*), ready to be tied with the knots in the rectum. B, sutures in rectal tear tied; reinforcing stitch (*r*) passed through ends of sphincter and appearing at apex of rectal tear, ready to be tied; vaginal sutures also placed.

of the mucous membrane, which are most numerous in the vestibulum and on the inner surfaces of the labia minora. Sometimes the tears are near the urethral orifice or they extend into it, and under these conditions will cause a burning pain during urination or will lead to retention of urine on account of the accompanying swelling. These injuries do not, as a rule, cause much hemorrhage, but at times they will do so, especially if one of the convolutions of blood-vessels known as the *bulbs of the vestibule* is involved.

Treatment.—Superficial tears of the mucous membrane of the vulva will heal without much treatment. They should be kept clean and may be dusted with iodoform. All deeper lacerations and those followed by hemorrhage are best closed by fine silk sutures. Union by first intention takes place almost invariably, and the stitches may be removed on the fourth or the fifth day.

When there is retention of urine it may become necessary to use the catheter until the swelling has subsided. Often, however, the patient will be enabled to urinate spontaneously if the vulva is well cleansed with some warm antiseptic solution, and a bed-pan half filled with hot water or with hot chamomile tea is placed under the pelvis in such a manner that the vapor comes in contact with the swollen parts.

FIG. 124.—Vaginal and rectal sutures tied; sutures placed to repair perineal body.

Injuries to the Perineum.—Ruptures of the perineum constitute the commonest injuries of labor. In primiparæ the frenulum tears almost always, and more extensive lacerations will occur in at least one-third of the cases. In multiparæ the lacerations are less frequent and are usually less formidable; they may be avoided altogether in nine cases out of ten.

For practical purposes lacerations of the perineum are divided into lacerations of the first, the second, and the third degree, according to their extent. Whenever one-half of the perineum is left uninjured, the laceration is one of the *first* degree. When the tear extends farther back, even as far as the sphincter ani, but without involving that structure, then there is a laceration of the *second* degree. The lacerations of the *third* degree, also called "complete ruptures of the perineum," extend through the sphincter ani into the rectum (Figs. 123, 124). At times we meet with a laceration of the perineum that cannot be brought under either of these headings. We refer to the so-called "central rupture," in which the anterior and the posterior boundaries of the perineum remain uninjured, while the central portion becomes torn and perforated and may even afford passage to the fetus.

In addition to the perineal lacerations just enumerated, tears extending up one or both lateral sulci of the vagina (Fig. 125) are of very frequent occurrence, and the resulting injury to the levatores ani muscles destroys in varying degree the subsequent usefulness of these structures as supports to the pelvic viscera. Indeed, this type of so-called "perineal laceration" is perhaps of greatest importance, since it is the factor which more than any other determines subsequent relaxation and consequent displacement of the pelvic organs. It should also be remembered that the integrity of the levatores ani muscles may be destroyed by being over-stretched without apparent laceration of the superimposed vaginal tissues.

Causes.—In primiparæ with the best of care and under perfectly normal conditions ruptures of the perineum cannot altogether be avoided. No matter how much softened and how yielding the parts become, the passage of the fetal head forces the vulvar ring so far open that in most cases there will be a giving way of tissue at the moment when the greatest diameter of the child's

head passes this ring. In vertex presentations, with rotation of the occiput forward, this moment arrives after the greater fontanelle has appeared in front of the frenulum, the fetal head going through the pelvic outlet with its lesser oblique diameter. In all other presentations the chances for rupture are very much increased. They are greatest in face presentations, in which the chin has to rotate forward and the head leaves the vulva in its greatest diameter, the greater oblique. The causes of the rupture are also frequently found in the peculiarity of the maternal tissues. Small women with narrow vaginal openings may give birth to good-sized children and escape with scarcely a scratch, the parts possessing a wonderful elasticity; while in other women perfectly healthy, and having the parts of good dimensions and apparently quite elastic, the parts tear easily and extensively when the test comes. In still other cases the

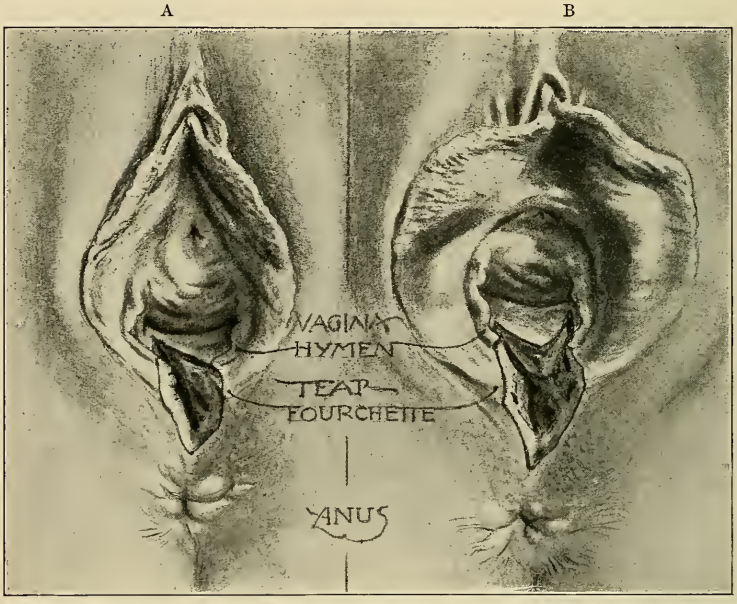


FIG. 125.—Perineal lacerations: A, laceration extending up right lateral sulcus. B, laceration involving both lateral sulci.

conditions are such that we know beforehand that the elasticity of the parts is below the average. This absence of elasticity is usually found in elderly primiparæ, especially when they are above thirty-five years of age. Moreover, a protracted labor will make the perineum dry and unyielding, or it may cause an edematous or inflammatory swelling, which in turn frustrates all efforts on the part of the obstetrician to avoid a rupture. A proper guarding of the perineum and a slow transit of the fetus through the pelvic outlet tend to avoid lacerations. Precipitate labors and labors without skilled assistance must therefore increase the chances for such injuries.

Symptoms.—A burning pain is usually the only symptom that a lacerated perineum causes at the time of its occurrence. In some few cases there is free hemorrhage from torn blood-vessels, but these cases are exceptions, and the

bleeding generally does not amount to more than a free oozing of blood from the raw surfaces. If left to themselves, most ruptures of the first and second degree will heal spontaneously; the more extensive ones will heal by granulation and cicatrization, leaving the parts in an unyielding condition for subsequent labors. The ruptures of the third degree extending into the rectum and

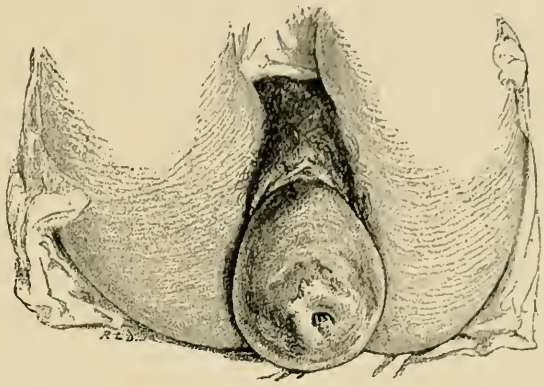


FIG. 126.—Complete prolapse of the uterus and vaginal walls following extensive and ununited perineal laceration.

those involving the levatores ani muscles seldom heal spontaneously. The later consequences of an ununited perineal laceration are a gradual descension of the vagina and uterus, starting with prolapsus of the anterior vaginal wall, and often ending with complete inversion of the vagina and complete prolapsus of the uterus, so that there is found in front of the pelvic outlet a large tumor, the covering of which is formed by the vaginal mucous membrane except at the apex, where the os uteri externum is visible. The body of the uterus is found inside this tumor (Fig. 126). In complete ruptures the impairment of the sphincter ani makes it impossible for the patient to control the passage of gases and of liquid fecal matter, and it renders her condition so miserable that she usually applies for a surgical restoration of the injured parts long before a prolapsus has had time to develop. The principal danger, however, from lacerations of the perineum of any degree is found in the great liability they offer to septic infections of all kinds during the lying-in state. The lacerations form large raw surfaces which are ready to absorb and to carry into the system any infectious material that may be brought near them. Thus, infection from outside sources, such as may be communicated by the hands or the instruments of physicians and nurses, will take place with greater facility and surety when the perineum is torn than if the *materia peccans* would have to reach the cervix uteri before it could find an easy entrance into the lymphatic and vascular systems. The experiments of Kehrer of Heidelberg have demonstrated that the lochial discharge of healthy puerperæ contains pyrogenic and phlogogenic elements; thus we find that lying-in women with perineal rupture have fever from absorption of the normal lochial discharge while passing over the raw wounds. This fever subsides as soon as healthy

granulations spring up to form a living barrier against further absorption. If the lochial flow becomes offensive from any cause, then its absorption will not produce simple elevation of temperature, but will be followed by puerperal septicemia with more or less local manifestations.

Treatment.—The first object of the treatment of lacerations of the perineum must consist in trying to avert them, or where this is not practicable at least to limit their extent so far as possible. Supporting the perineum at the time the head passes, securing the proper mechanism at the moment of its delivery, and, most important of all, resisting too rapid expulsion by forcibly retarding the expulsion of the head and by crowding the latter well against the under surface of the symphysis, will often avoid extensive laceration. The details of managing the birth of the head and the methods to be employed to avert serious injury to the pelvic floor have been described and illustrated on page 419, Vol. I. During the passage of the shoulders the support must be continued, for often the passage of the head causes just the smallest tear, perhaps extending only through the frenulum, and, if the shoulders are allowed to pass carelessly, this tear may be increased to great dimensions.

When the uterine contractions are so violent that they tend to force the fetal head out with great rapidity, they should be regulated by a hypodermatic injection of morphin, or, still better, by inhalations of chloroform. If a rupture of the perineum is apprehended, it is advisable to deliver in the lateral position (see illustration, p. 422, Vol. I.). The passage of the head will be slower than in the dorsal position, and the parturient woman can use less force in bearing down. The perineum can be more closely observed, and, in suitable cases, an impending laceration may be avoided by the so-called "bilateral incisions" or episiotomy, an operation described and illustrated on page 423, Vol. I. (see Fig. 205, Vol. I.). Many a laceration of the perineum may thus be avoided, and a clean incised wound, which can easily be united by one or two sutures, is substituted for a torn wound, whose extent could not be foreseen.

In cases in which the perineum appears rigid, warm moist applications during labor will help to soften the parts; chloroform-inhalations carried to complete anesthesia seem also to render the tissues more yielding. Where the delivery is accomplished by the aid of forceps, an impending rupture of the perineum may be avoided by taking off the instrument just before the greatest diameter of the child's head passes the pelvic outlet; otherwise the instrument will help to augment the distention of the vulvar ring and will make a laceration more probable. If the forceps, however, is not removed, it should be used to hold the head back during expulsive efforts and thus permit gradual dilatation of the vaginal outlet.

When these prophylactic measures fail to prevent a rupture of the perineum, it becomes the duty of the obstetrician to see that the injury is repaired in the manner previously described (page 428, Vol. I.) and immediately after the completion of labor. No physician should attend a case of labor without carrying in his satchel the necessary implements for suturing perineal lacerations.

Complete lacerations are the only cases in which a good obstetrician may

defer repairing the injury until he can obtain skilled assistance, yet it is desirable that they should be attended to within twenty-four hours after delivery.

The after-treatment is very simple, and is usually limited to irrigations of the wound with an antiseptic wash and to keeping the parts covered with proper dressings. When vaginal irrigations are employed, care should be taken that the nozzle of the syringe does not disturb the sutures and the juxtaposition of the wound. The external or perineal sutures are removed on the fifth or sixth day, while the vaginal and rectal sutures may be left in place a few days longer. Treated in the way previously described, about 75 per cent. of lacerations of the perineum will heal by first intention. When the union is incomplete, the defect is often made good by granulation.

Sometimes the tissues of the vulva are in such a bruised, swollen, and unhealthy condition that a union of the parts cannot be expected; it is better in these cases not to attempt closing up by sutures. At other times, the parts having been sewed up, there develop symptoms of puerperal infection which make it necessary to reopen the wound; as, for instance, when the lochial discharge has found its way between the wound-edges and is entering the system through pockets which cannot be disinfected without laying the parts well open. In the latter cases the wound has to be frequently irrigated with antiseptic solutions, and the formation of granulations must be assisted as much as possible by the lavish use of powdered iodoform. Whenever the wound-surface looks unhealthy and is covered with a grayish coating (diphtheritic plaques), applications of the following dressing will be found of the greatest service:

℞. Olei terebinthinæ, ℥j;
Olei olivæ, ℥iij.—M.
Sig. Locally.

Not only does the spirit of turpentine act as a good antiseptic agent and as a powerful promoter of granulations, but it also acts as a stimulant to the general system, and its use is therefore perfectly safe even in those low conditions in which the free application of some one of the other antiseptic remedies might be fraught with danger. The mode of applying the turpentine is simple. After the wound has been cleansed by irrigations, its edges are well separated by the hand and a flat layer of absorbent cotton soaked in the turpentine mixture is introduced between them. The dressing is renewed three or four times a day until the surface of the wound is entirely covered by granulations, when the ordinary treatment may be resumed.

Injuries to the Vagina.—With deep perineal ruptures there is always more or less laceration of the posterior vaginal wall (see page 189), but there are also found tears of the vagina that are not so connected. These injuries may be superficial, involving the mucous membrane only, or they may extend through the muscular coat of the vagina, laying open the pelvic cellular tissue

or penetrating into the surrounding viscera. If the injury is located at the upper portion of the posterior vaginal wall, the peritoneum may be exposed or the abdominal cavity may be opened.

After protracted labors, especially when there is a narrow pelvis or a disproportionately large child, we sometimes find contusions of the vagina that later on cause sloughing of the mucous membrane, followed by cicatrization and constriction of the entire vaginal canal. At other times circumscribed portions of the upper vagina have been contused to such a degree that in a very few days they become necrotic and lead to perforations of the wall. These injuries are particularly likely to happen when in a flat pelvis the fetal head has for hours been wedged in between the symphysis pubis and the promontory. The pressure-marks in the vagina correspond in such cases with similar marks on the fetal head (see Fig. 23, p. 37); they are of round or oval form, measuring from 1 to 2 centimeters ($\frac{3}{8}$ to $\frac{3}{4}$ inch) in diameter, and, becoming gangrenous, ultimately produce vesico-vaginal or recto-vaginal fistulæ, as the case may be. At times we meet with submucous lacerations of the vaginal wall, resulting in the formation of more or less extensive hematoma.

Causes.—A narrow and unyielding vagina, especially in primiparæ of advanced age, will often be the cause of these injuries. A rapid passage of the fetal head, an over-distention of the parts by abnormal positions of the fetus, will also work in the same direction. Sometimes the vagina is ripped open by undue sharpness and projection of the spines of the ischium or by abnormal excrescences of the pelvic bones. At other times the injury has been brought about by splinters of fetal bones present during craniotomy or embryotomy. The most extensive laceration of the vagina ever observed by the writer was caused by the use of the forceps in unskilled hands. An elderly primipara was delivered by a midwife, who had not only applied forceps, but had also sewed up in the rudest manner an extensive perineal laceration. The writer saw the patient four days after the operation, and found in the middle portion of the vagina, backward and to the left, a longitudinal gap through which could be passed the entire hand into a cavity filled with coagulated blood.

Symptoms.—Injuries of the vagina do not at first cause much disturbance unless there be a free hemorrhage; in the rare cases in which the peritoneum has been injured, the symptoms of peritoneal irritation, such as pain and nausea, will not be missing.

Prognosis.—Deep lacerations of the vagina are of grave importance. They allow the direct entrance of the lochial discharge into the cellular tissue, and are therefore very often followed by pelvic inflammation and by pelvic abscess. The contused wounds often cause extensive sloughing of the vaginal mucous membrane, and lead later on, by cicatrization, to a stricture of the vagina that may approach an occlusion. Necrosis of circumscribed regions of the vaginal wall lead, as already mentioned, to the formation of vaginal fistulæ.

A hematoma usually disappears without leaving bad effects, but at times its contents decompose and threaten the general system with septic infection.

Superficial lacerations may heal spontaneously without causing any symp-

toms, but more frequently they become infected by the lochial flow, and are changed into puerperal ulcers which cause more or less disturbance, and which finally heal by granulation, leaving in the vaginal wall a scar which in subsequent labors may prove the source of further trouble.

Treatment.—Lacerations of the vaginal mucous membrane, if in any degree extensive, should always be united by sutures if recognized soon after their occurrence, and they will usually heal by first intention. Penetrating wounds with escape of blood or of secretions into the cellular tissue are kept clean by frequent irrigations with antiseptic solutions, followed by packing the wound-cavity with iodoform gauze. After severe contusions with unavoidable sloughing of the mucous membrane the patient can often be kept free from septic infection by the use of permanent irrigations. For this purpose a large tank or irrigator is filled with sterilized water and placed near the bed, at a height not exceeding 60 centimeters (2 feet) above the patient's genitalia; a vaginal tube, which is best made of glass, is connected with the tank by rubber tubing, and the flow is controlled by a faucet. The patient is placed on an air-cushion over a bed-pan (or a tin box made for the purpose), which in turn has a waste-tube leading to a larger vessel on the floor. The faucet is so set as to allow the water to flow very slowly or merely to trickle; the tube is inserted into the vagina and is kept in position by tapes tied around the thigh or the waist of the patient; the vulva is covered with antiseptic dressings. In this way a little stream of sterilized water is kept running over the contused parts, washing away the lochial flow and every particle of débris as soon as formed. Several times a day an antiseptic wash is placed in the tank and a full stream is turned on, to give the parts a thorough disinfection. Most patients can stand this treatment for twenty-four hours and longer; they pass the urine without necessitating a stop in the irrigation, and they rest quite comfortably. Others complain so much of discomfort that the irrigation cannot be continued for more than three or four hours at a time, but even in this imperfect application it will do a great deal of good.

Hematoma.—Subcutaneous and interstitial bleeding, forming a circumscribed blood-tumor, is a rare complication of the puerperium that may be attended with considerable danger. Since the monograph of Deneux, all systematic writers on obstetrics have discussed these blood-formations, and the only new feature that modern obstetrics has added to the subject is a lowered mortality under the newer antiseptic methods of treatment. This accident, which is rare, occurring once in about 1600 labors, is commonly caused by pressure-laceration or necrosis of one or more veins which have not been able to withstand the strain of the increased venous pressure occurring during labor. Exceptionally the rupture has occurred in the latter part of pregnancy, and very rarely the torn vessel may be an artery, as in a case reported by Simon.

Etiology.—Several conditions have been reported as predisposing causes, the most important, doubtless, being weakening of the vessel-wall by disease. Varicose veins of the vulva and vagina are of common occurrence, and, *a priori*, they would seem to predispose to this accident, yet the rarity of hematomata

and the fact that most cases have not been preceded by markedly varicose veins force the conclusion that in themselves they are not a factor of first importance. Croom has asserted that anterior displacement of the uterus, producing a pendulous abdomen, is a factor by stretching the posterior vaginal wall and tearing its vessels before the head descends into the pelvic canal. Hypertrophy of the cervix, the use of instruments, excessive size of the head, undue length of the labor, and prolonged and powerful expulsive efforts have been said to favor the occurrence of hematomata.

Symptoms and Signs.—The swelling formed by the extravasated blood usually does not appear until labor is ended, and in some cases even several days later, the time of its appearance depending upon the kind of injury the veins have received. When the vessel has been ruptured early and the presenting part has not advanced sufficiently to exert direct pressure upon the injured veins, the tumor appears at once, and, immediately reaching its full size, may seriously obstruct labor; if, however, the presenting part exerts sufficient pressure to control the bleeding temporarily, the tumor may be very small or may not be noticed until after labor. When the vein which is subjected to prolonged compression is only contused, and which later gives way either spontaneously or after sudden exertion, as coughing, straining at stool, or during micturition, the tumor first appears in the puerperium, usually within a day or two, but very rarely so late as the twenty-first day, as in a case reported by Helfer. The situation of the tumor varies; anatomically it is determined by the distribution of the fascia, either of the pelvis or of the perineum. Usually the blood is effused below the pelvic fascia, and the tumor appears in the labium, or beneath the vagina, or in the perineum, extending exceptionally to the anus, to the gluteal region, and in front to the abdominal walls. If the bleeding has occurred above the pelvic fascia, the effused blood may be situated in the broad ligaments or the periuterine connective tissue, and it may extend even to the diaphragm. Very rarely the tumor may be found in the cervix. Clinically, the commonest site of the swelling is at the side of the vagina near the vulva. The size of the tumor also varies. Usually not larger than an egg or one's fist, the tumor may be as large as a cocoanut, or, widely distributed, it may contain a very large quantity of blood. A hematoma, polypoid in shape, has been observed hanging from the vagina.

The formation of a hematoma is generally accompanied by pain in the region affected, this pain being very severe when a large tumor is formed. There are at the same time constitutional evidences of hemorrhage that also vary in their severity in direct proportion to the volume of the tumor. Should the swelling reach its full volume at once, and burst—an unusual complication—the loss of blood may rapidly be fatal. In some instances the tumor continues to enlarge for twenty-four hours. Soon after its formation it assumes a livid or mottled appearance, at first giving tense fluctuation, but later a clot-like firmness. By pressing upon the bowel or the bladder the functions of these organs may seriously be interfered with, and when the swelling reaches a considerable size during labor it may impede the birth of the child or the pla-

centa, and later may obstruct the lochial flow. The symptoms being practically characteristic, the *diagnosis*, therefore, is generally easy when the tumor is visible or is easily accessible in the lower parturient tract. The tumor might be mistaken for prolapse or inversion of the uterus or the vagina, for varicose veins, or for vaginal enterocele. When the effusion has taken place within the pelvis, the diagnosis will be made by a bimanual examination, together with the mode of onset and the constitutional signs of internal hemorrhage.

The termination of a hematoma may be any one of the following: (*a*) Absorption; (*b*) recovery after evacuation of its contents; (*c*) septic infection before or after rupture; (*d*) hemorrhage, which may prove rapidly fatal before rupture or at the time of rupture. Rupture may be the result of undue or sudden effort, or, at a later period, it may occur spontaneously from sloughing. The ultimate result, which in any case will depend upon the size and situation of the tumor, is also largely influenced by the treatment pursued. Small tumors not larger than an orange are usually absorbed, while those of larger size frequently burst spontaneously and thus add to their gravity. Of 30 cases collected by Winckel, twenty-three spontaneous ruptures occurred within eight days. If, on the one hand, the larger tumors are opened before necrotic changes or renewed hemorrhages have occurred, the prognosis is favorable, and with rigid antiseptic treatment death should be exceptional; if, on the other hand, delay permits such changes, the mortality is 12 per cent. (Winckel).

The situation of the tumor influences the prognosis to the extent of its being accessible, and thus being more readily dealt with. Intrapelvic tumors, therefore, are more dangerous, the hemorrhage being less readily controlled and the danger of suppuration being greater. Tumors appearing during labor have had a higher mortality than those occurring after delivery.

The treatment of a hematoma varies with the time of its appearance, its size, and its situation.

Should the swelling occur before or during labor, and offer a serious obstruction to the passage of the child, the tumor should be laid open in its dependent portion, to favor subsequent drainage, preparations having previously been made to control the free hemorrhage almost certain to follow evacuation at this time. Manual compression by an intelligent assistant can be utilized to control free bleeding while the bleeding vessels are being searched for and ligated. If this cannot be done readily, forceps should be used to draw the head into the vagina until by the pressure of the head the bleeding is controlled. Even when the tumor is not large enough to impede the passage of the child, it is best to anesthetize the patient to prevent excessive straining on her part, and to apply the forceps and to employ cautious extraction to prevent further bleeding and increase in the size of the swelling. If the forceps is not employed, or in case the swelling first appears after labor, an attempt should be made to control the hemorrhage by the application of cold and by pressure, both of which can conveniently, and usually effectually be applied by means of the largest Barnes' bag or by a colpeurynter placed in the vagina and filled with ice-water, ice poultices being placed against the labium. If the swell-

ing ceases to enlarge—an indication that bleeding has been controlled—and if the tumor is not larger than one's fist, efforts should be made to promote its absorption by cooling applications, such as compresses wet with lead-and-opium wash or with diluted alcohol. Meanwhile the vagina must be kept clean by frequent antiseptic douches, and the patient should be cautioned to avoid all efforts at straining. It is therefore desirable to use the catheter and to keep the stools soluble.

After waiting a few days, if there are no signs of absorption, and if the tumor, which had been hard, now becomes soft, and the overlying skin or mucous membrane is tense, discolored, or vesicated, indicating, as these changes do, beginning suppuration or threatening spontaneous rupture, the time has arrived for prompt evacuation of the tumor. An incision 5 to 7.5 centimeters (2 to 3 inches) in length should be made along the inner surface of the labium, the clots turned out, bleeding vessels ligated, and the cavity daily cleansed and packed with antiseptic gauze.

When symptoms of internal bleeding and physical examination point to the occurrence of a hematoma within the pelvis, care must be taken to exclude free hemorrhage in the peritoneal cavity from a ruptured broad ligament or other vein, since the latter condition would necessitate opening the abdomen, while in the former, if the hemorrhage is confined within the connective tissue, the shock and collapse should be combated, and effort be made to limit the hemorrhage by cold and by the internal administration of hemostatics. Subsequently the tumor should be watched, and, if not absorbed, it is best to evacuate it through the vagina. If not extensive, and if there are no marked constitutional evidences of internal bleeding, the condition will probably go unrecognized until spontaneous evacuation occurs or until incision is made after several weeks or months, as in a case of Tergrigoriantz, in which case a broad-ligament hematoma through pressure-necrosis communicated with the posterior vaginal vault, and was emptied of stinking, bloody fluid after four months.

II. Diseases of the Sexual Organs.

1. Puerperal Infection.

By "puerperal infection" is here understood all the manifold diseased conditions in puerperal women caused by microbes or their products, except eruptive fevers; non-inflammatory diseases of the nervous system, such as tetanus, tetany, and insanity; and inflammation of the breasts,—all of which are discussed in other parts of this work.

Some authors take the term "infection" in a narrower sense, distinguishing between *infection*, which, according to them, is produced directly by the microbes entering the tissue, and *intoxication*, which is due to the absorption of the toxines produced by the microbes. But since there is no sharp line of demarcation between the two kinds of noxious influences, and bacteriologists still differ among themselves, and since, in most cases in private practice,

where the large majority of cases of disease in the puerperium occur, no examination to settle the question is made or can be made, I prefer to retain my old definition.

Puerperal infection in almost all cases is a wound-infection, and, just as this may be slight or be serious, puerperal infection may be a local affection of the external genitals of little importance; or it may be a more serious affection of the internal genitals, especially the uterus; or the whole system may be drawn into the morbid process. In most books this condition is treated of under the name "puerperal fever," a denomination from which the writer entirely abstains, for the reason that it is absolutely impossible to draw a distinct line anywhere on this field as a limit for something worthy of that name. The old idea of puerperal fever as an essential fever, a nosological entity *sui generis*, is given up by all. It is impossible to define puerperal fever, and it ought to follow the terms dropsy, lung fever, and brain fever, which have long ago been relegated to the scientific lumber-room for terms fallen into desuetude and have given way to definite and correct expressions. The term "puerperal fever" ought the less to remain in scientific language, as in some of the worst cases there is no fever at all.

Of late years, instead of "puerperal fever," the term "puerperal septicemia" is used by many, which is certainly an improvement, in so far as it reminds us of the identity of puerperal infection with wound-infection; but the expression is both too wide and too narrow for our purposes—too wide, because the same word has a more restricted sense of a certain form of puerperal infection in contradistinction to other forms; too narrow, because the word by its etymology means a condition where septic material circulates with the blood through the whole body, and because the term cannot properly be made to encompass many diseased conditions found in the puerperal woman, which conditions in most cases never lead to a general infection of the whole system.

The term "puerperal infection" is open to the criticism that it means a cause, and not the effect produced by this cause, but this is not without analogy in common parlance. The word "cold" meant originally a low temperature, but by extension it has been made to comprise as well the disturbance in the human body caused by exposure.

By using the expression "puerperal infection" to designate the diseased conditions produced by infection during pregnancy, childbirth, and the puerperal state we have the advantage of having a general term which covers the whole ground, mild and serious cases, local and general disturbances in the equilibrium of health. We are furthermore reminded of the possibility of guarding our patients against a pest that not long ago was thought to be due to a deterioration of the atmosphere, or even to a direct retribution of an irate deity; and we are turned in the right direction for finding therapeutical relief for evils already existing. We stand also on pure scientific ground, since all modern research proves that in the mildest and in the severest cases the morbific element ordinarily is the same—namely, the pres-

ence of the different species of *staphylococcus pyogenes* (Fig. 127) and the *streptococcus pyogenes* (Fig. 128).

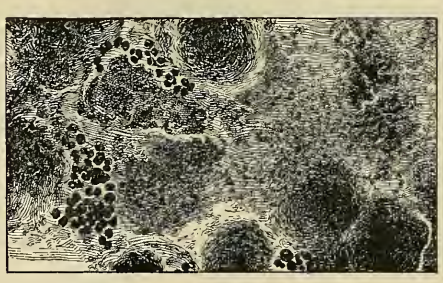


FIG. 127.—Staphylococcus pyogenes aureus in pus (× 1000) (Fränkel and Pfeiffer).

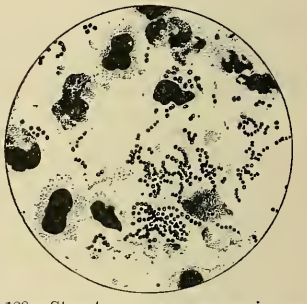


FIG. 128.—Streptococcus pyogenes in pus (× 1000) (Fränkel and Pfeiffer).

The celebrated French microscopist Cornil[1] states that the streptococci found in patients affected with so-called "puerperal fever" are the same as those first described by Fehleisen as the cause of erysipelas. He found the same coccus in all the different forms of puerperal infection—pyemia, septicemia, the diphtheritic and the phlebitic form. Only once did he find a rod-shaped bacillus.

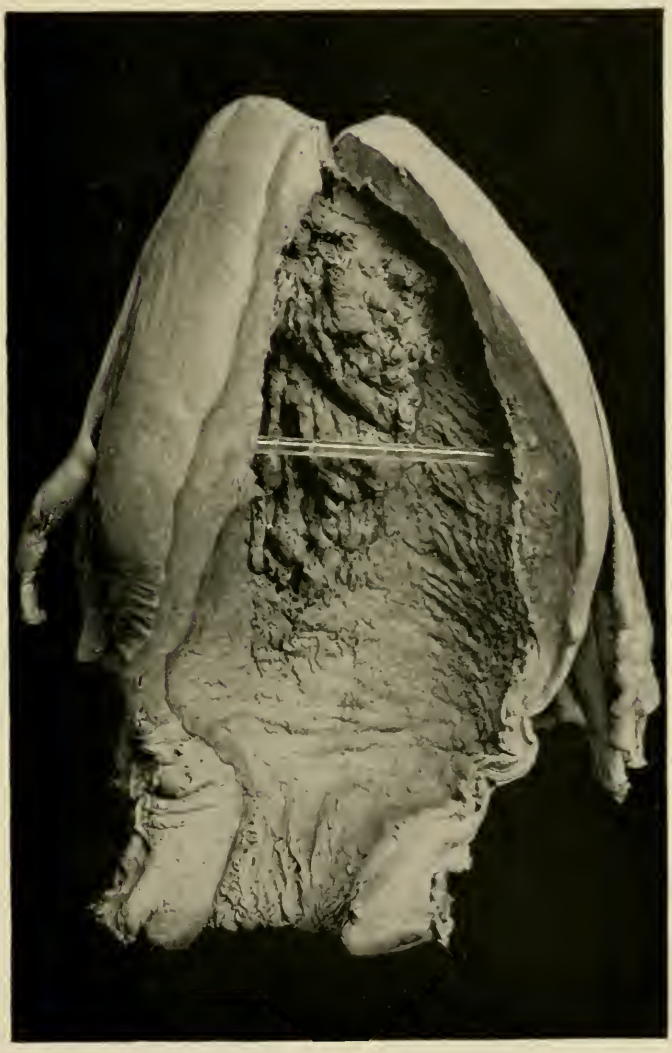
Clivio and Monti of Pavia[2] found in five cases of puerperal peritonitis in the fluid contained in the abdomen a streptococcus which was identical with Fehleisen's streptococcus of erysipelas and with Rosenbach's streptococcus of suppuration, and similar streptococci were found in phlegmonous abscesses in other diseases. Lustig of Turin[3] found this same streptococcus in the blood of the spleens and the hearts of women who died from puerperal endometritis and peritonitis.

Bumm,[4] who made extensive researches with ample material, likewise arrives at the conclusion that the streptococci found in puerperal infection are identical with those found in infected wounds. Mirónow[5] also identified the streptococcus of erysipelas with that gathered from the uterus of sick puerperal women.

It would seem that the bacteriologists are less sure of the correctness of their assertions than they were six years ago, when this chapter was written. In 1899 the German Gynecological Society had chosen "puerperal fever" as a special subject of discussion. Some of the greatest obstetricians and bacteriologists were present, but there was little unanimity, either in bacteriological investigations or in the practical measures of treatment based thereon. Even so fundamental a fact as the presence or absence of fever producing microbes in the vagina of pregnant and parturient women seems still to be doubtful, and Kroenig, who was formerly the banner-carrier of those who denied their presence, has changed his mind in this respect.*

Burkardt has examined the interior of the womb during the puerperium. During the first five days, and sometimes as much as eight, no germs are

* Kroenig, *Centralbl. f. Gynäk.*, 1899, p. 697.



Specimen from a patient who died septic, showing the material that would be found to be removed by the curette or the finger on the "roughened placental site." "Clots in the uterine sinuses" (Army Medical Museum, Washington, D. C., No. 10,619).

found. After the eleventh they abound, and there are even plenty of streptococci; but since the patients all remained well, except for a slight rise in temperature, he thinks there must be two kinds, the very dangerous streptococcus pyogenes and the innocuous streptococcus saprogenes.* Koblanck found streptococci in the vagina of 19 puerperæ. The 13 were perfectly well, and the 6 had only a slight fever.† It is, therefore, likely that the mild fever frequently observed in puerperal women is due to a secondary infection, the parturient canal being a wound in continuity with the skin. The whole matter is of little practical importance.

On the other hand, very serious illness and death may be due to gonococcus, pneumococcus, and bacillus coli communis. Döderlein‡ found that the streptococcus pyogenes was the most important; and next to it the pyogenic species of staphylococcus; and others found the above-named microbes, either in connection with streptococcus or alone, as the cause of the most severe inflammation.

Different Forms of Infection.—First of all, we must distinguish between mere *local* affections and a *general* infection reaching the whole system. The former are, of course, much less dangerous than the latter. Next, we must separate the *putrid* from the genuine *septic* infection, both of which may be local or be general. General putrid infection is called *sapremia*, and general septic infection is called *septicemia*.

Putrefaction and sapremia are due to many different schizomycetes, the so-called *saprophytes*—minute organisms which are allied to algæ, and are found all over the world in streams, plants, animals, etc. By their growth and multiplication these organisms produce certain chemical substances, the so-called *toxins*, a kind of ptomaïns which give rise to fever. *Ptomaïns* are alkaloids produced in dead vegetable and animal tissues during putrefaction; *leucomaïns* are similar alkaloids produced in living animal tissues as a result of their activity. Ptomaïns are produced only by microbes, and are usually poisonous. Leucomaïns are harmless unless their excretion is interfered with.

The changes occurring in puerperal infection may be produced by ptomaïns or by leucomaïns alone, without the presence of microbes, but in the vast majority of cases the microbes are present. The saprophytes are generally brought into the interior of the uterus mechanically.

Septicemia is due to a few well-known microbes that actively enter the tissues, which they injure through their growth, and by their distribution throughout the body may so change the chemical processes and normal functions that death ensues. These microbes are, as we have stated, chiefly streptococcus pyogenes, and are identical with those that cause wound-diseases; and in the second line comes staphylococcus pyogenes albus. These two genera of microbes were therefore also called *pathogenic* microbes, which

* Burkardt, *Centralbl. f. Gynäk.*, 1899, p. 1274.
† Koblanck, *Centralbl. f. Gynäk.*, 1899, p. 1383.
‡ Döderlein, *Centralbl. f. Gynäk.*, 1891, p. 39.

give rise to so-called *specific* puerperal diseases, and which are different from the so-called *non-pathogenic* microbes, that cause only putrefaction and *non-specific* puerperal disease. But according to the later investigations just mentioned, the list of pathogenic microbes now is made to comprise the bacterium coli commune, the gonococcus, the pneumococcus, the bacillus diphtheriæ of Klebs-Loeffler, besides the bacillus tetani, which is the exclusive cause of tetanus in puerperal women as in other persons and animals. And, besides, the same species may be pathogenic and non-pathogenic.

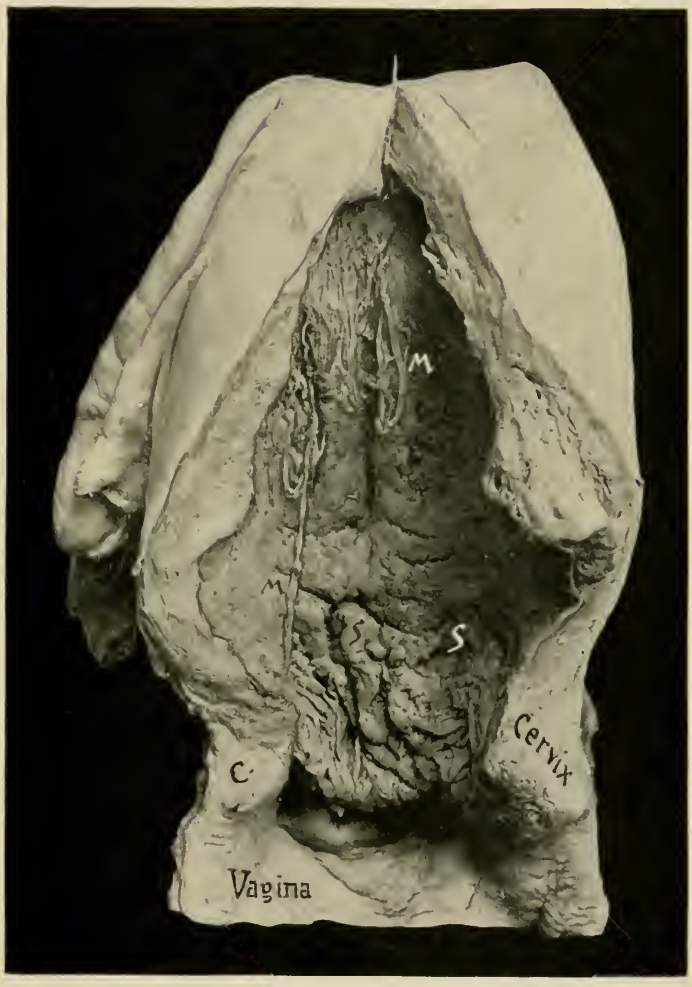
The infection starts, in the vast majority of cases, from the endometrium. Bumm[8] distinguishes, in accordance with what has just been said, a *putrid* from a *septic endometritis*, but he admits that in some cases the two forms are blended. In *putrid endometritis* there is found in the uterus a superficial layer of necrotic tissue, under which is a layer of granulation-tissue filled with leucocytes, those formerly much-maligned colorless blood-corpuscles that have since the advent of bacteriological studies proved to be our truest friends, forming a bodyguard that protects us against the constant attacks of our enemies, the microbes, which their minute bodies engulf and absorb. Hence they have received the name of "phagocytes"; that is, "devouring cells," a species of giant-killers on a small scale. While the necrobiotic layer is covered with all kinds of saprophytic bacilli and cocci, these are said never to enter the granulation layer. But according to Krönig,* saprophytes may penetrate the tissues and cause para- and peri-metritis.

Septic endometritis differs according to its being a local affection or an inflammation followed by general infection. In *local septic endometritis* the endometrium is much like that in putrid endometritis, except that, besides more or less numerous germs of putrefaction, streptococci are found.

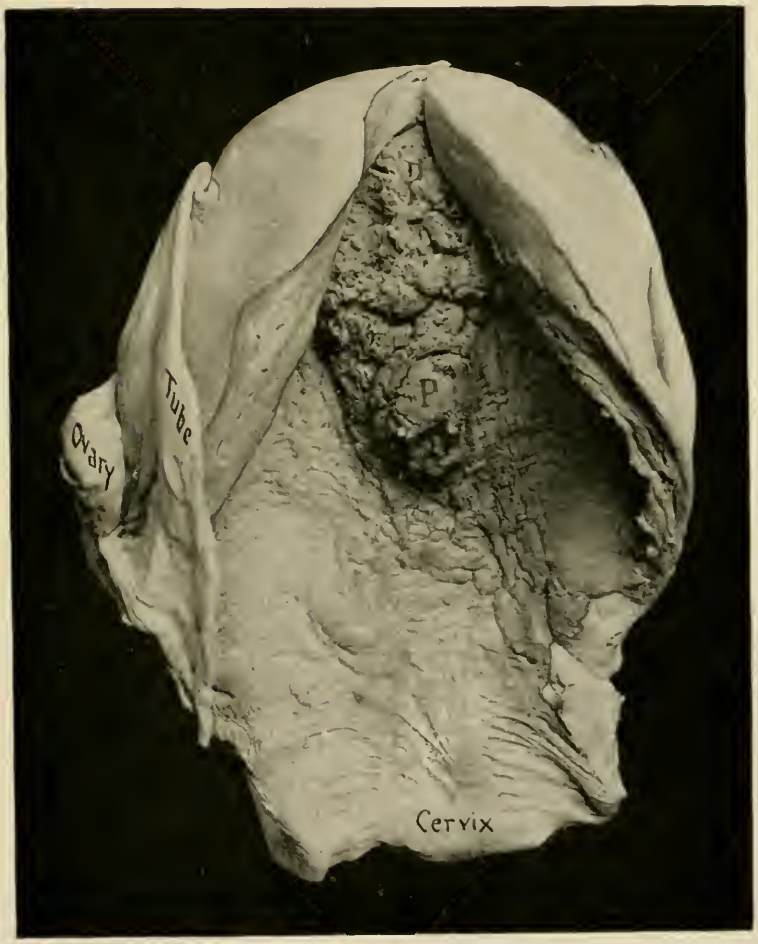
General septic endometritis appears under two different forms—the *lymphatic* and the *thrombo-phlebitic*. In the *lymphatic* form there is a mixture of saprophytes and streptococci on the necrotic surface, but the granulation-wall is much thinner than in putrid endometritis, and in the worst form of sepsis it is altogether absent. On the placental site the veins are well closed, their walls being in contact and without thrombi. In the severest cases the infection-carriers go through the finest lymph-spaces between the tissue-elements. In less rapid cases they generally follow the larger lymph-vessels. From the wall of the lymph-vessels they enter the surrounding tissue, causing necrosis. The lymphatic form often starts from injuries of the cervix. In septic peritonitis the infection is not propagated through the Fallopian tubes, but it takes place through the lymphatics of the walls of the uterus.

In the *thrombo-phlebitic* form of general infection the endometrium is like that of localized endometritis, the germs, according to Bumm, never entering the layer of granulation tissue filled with leucocytes except at the placental site. Here the veins have not been closed by collapse and apposition of their walls—the normal process—but are plugged with thrombi. In some of these thrombi we find, superficially, saprophytes and streptococci, but the latter,

* *Centralbl. f. Gynäk.*, 1899, p. 679.



Uterus with shreddy material (M, M) and sloughing strip "encircling internal os" (S, S); from a girl of nineteen who died eight days post-partum with puerperal peritonitis (Army Medical Museum, Washington, D. C., No. 8957).



Portion of placenta (P) remaining *in utero:* death from sepsis five days after delivery in a typhoid condition. Colored girl, nineteen years old, syphilitic, with dead fetus at term (Army Medical Museum, Washington, D. C., No. 7784).

finding a favorable soil in the thrombi, enter into their interior, while the saprophytes remain near the surface. The invaded thrombus soon forms a detritus, a process that extends into the broad ligament. The thrombophlebitic is a more rapid and a more dangerous form.

The *diphtheritic form* of puerperal infection begins in the mucous membrane of the vulva, vagina, or uterus, or in a tear extending into the surrounding connective or muscular tissue, and patches, like those found in a diphtheritic wound or in the throat of a patient affected with diphtheria, are formed. It is again the same streptococcus that is at work, and the affection passes into one of the above-described forms. Sometimes the Klebs-Löffler bacillus of true diphtheria is found.

The difference in symptoms and in the danger in different cases of puerperal infection may be accounted for in many ways. The different power of resistance may count for something, one organism succumbing to an attack which a stronger constitution successfully resists. The mere number of microbes seems to be of importance in all infections, the invaded body being capable of neutralizing a small number, but losing in the battle with the many.

The anatomical structure and connections of the part invaded explain many peculiarities in the result produced. An infection attacking one lymph-vessel leading to a gland may be cut short there, while if the infecting material enters another lymph-vessel it is carried to the peritoneum, and thence, perhaps, through the stomata of the diaphragm to the pericardium and the pleura. Or a thrombus in a vein breaks down, and part of the detritus is carried away with the blood-current through the vena cava, the right auricle, the right ventricle, and is deposited in a fine branch of the pulmonary artery, forming an abscess, from which the microbes are carried to other parts of the body to form new foci of suppuration.

Most important of all seem to be the different degrees of virulence of the microbes themselves. Virulence is a property of the protoplasm that shows itself in energetic proliferation and increased power of resisting the influence of the cells in the organism invaded. This virulence is diminished by artificial culture, and is increased in the animal body, but in what way is unknown. The virulent streptococcus rapidly invades the tissues.

The infection which starts from the genitals takes place through a wound, either an accidental tear or abrasion on the placental site, which has been compared to the stump left after the amputation of a limb; and microbes are found in the genital tract of every puerpera. In animals there is much less solution of continuity. With them, as a rule, the process of expelling their offspring is not more difficult than the act of defecation, and their placental site either regains its epithelium before the loosening of the placenta, or recovers it in a very short time after delivery, almost in minutes. This fact explains why puerperal infection is not produced in an animal by the injection of septic fluid into its vagina and uterus. As soon, however, as the same fluid is injected under the mucous membrane infection follows.[9]

In the opinion of the writer the so-called "puerperal fever" is nothing but the most serious form of puerperal infection. Localized is less dangerous than general infection; putrid infection is not so important as septic infection; but any local infection may become a general infection, and putrid infection may end in death.

Septicemia in Children.—Identically the same disease above described in puerperæ is often found in new-born children. The mother of the child may or may not have the disease. Infection in the child generally takes place through the navel, but it may enter through sores in the mouth or through an accidental wound, or it may be aspired into the lungs in the putrid liquor amnii or be inhaled through the air, or it may even pass from mother to child through the placenta. If not acquired from the mother before birth, the poison may be carried to the child by doctors or by nurses, or may cling to any object with which it comes in contact, or may float in the air. The sources of the poison in children are the same as those we shall now describe in regard to the mothers.

Etiology.—Experience shows that a puerpera is more liable to disease than is a woman in other conditions, and it is not difficult to give many good reasons why this must be so. The causes of puerperal infection are *predisposing* or *exciting*.

Predisposing Causes.—During pregnancy the chemical composition of the blood undergoes considerable change; the total amount of blood circulating in the body increases, but it is more watery than in the non-pregnant condition. In other words, the woman suffers from plethora and hydremia. The red blood-corpuscles diminish, while the colorless corpuscles increase in number. Hemoglobin, albumin, fat, phosphorus, and iron decrease in amount, whereas the quantity of fibrin is considerably greater than in the non-pregnant woman. The plethora, hyperinosis, and leucocythemia predispose to inflammation.

The heart, especially the left ventricle, becomes hypertrophic. The walls of the blood-vessels become thicker and their calibre larger, especially those in the uterus and the breasts. The lymphatics of the pelvis become so dilated that they look like veins. This dilatation of blood- and lymph-vessels predisposes to the formation of thrombi, which not only constitute a fertile soil for the pathogenic microbes, but also may break down and be carried away by the circulation to remote parts that become new centres of infection. The muscular tissue of the uterus grows enormously in order to afford room for sheltering, and force enough to expel, the fetus.

The nervous system is in a high state of irritation, as may be concluded from the headache, toothache, neuralgia, vertigo, and longings and aversions so common in the pregnant condition. Parturient and puerperal women are highly emotional. The presence of a disliked or dreaded person in the lying-in room may arrest labor-pains. A letter containing unpleasant news may cause a rise of several degrees in temperature. Shame in those who have "loved not wisely, but too well," fear of destitution in the poor, indignation at a husband's cruelty, are all factors that lower the vitality and diminish the

power of resistance. Since every muscular contraction and all secretory functions are controlled by nervous action, we can imagine that even the propagation of microbes, their distribution in the body, and their expulsion from it may be influenced by the condition of the nervous system.

At the end of labor the patient is exhausted by pain and loss of blood, and the genital canal is full of tears and abrasions, which open for microbes free access to the tissues. If this is true of even the most normal delivery, it applies with still greater force to tedious deliveries and to those in which the accoucheur must resort to operative interference, necessitating the introduction of fingers, hands, or instruments into the genital canal.

Normally, the muscular tissue should contract forcibly during the expulsion of the child, and should remain contracted until all veins on the placental site are closed by simple agglutination. But if the muscular contractions are defective, the woman may either bleed to death, or the veins may be plugged up by the formation of clots, which are an excellent soil for streptococci and staphylococci, and into the depths of which they therefore rapidly penetrate.

The separation of mother and child outside the placental site, which separation ought to take place in the areolar layer of the decidua, may be defective, so that larger or smaller pieces of membranes are left behind, and at the placental site a cotyledon may be torn off and remain in the uterus. Such remnants of the secundines soon become covered with saprophytes, and they undergo a putrefaction which may lead to more or less serious consequences. The entirely normal lochial discharge is in itself an excellent medium for the cultivation of all sorts of microbes.

After the birth of the child a retrograde process begins. The hyperplastic and hypertrophic tissues have to be liquefied and be reabsorbed, the intermediate stage being fatty degeneration. While before delivery there is a strong current of plastic material toward the uterus and the child, after delivery the direction is reversed, and a strong current carries effete material from the genitals, especially the uterus, to the rest of the body.

Primiparæ are still more exposed to infection than those who have before borne children, labor being longer, the canal to be traversed being narrower, and the parts composing it being softer.

Delivery in general hospitals exposes the patients to greater dangers than delivery in special lying-in institutions or in their own homes. Parturient women ought not to be in the same room with puerperæ, the discharges from the latter being particularly dangerous to the former. The crowding of too many puerperæ into one room is in itself dangerous. The less the space the greater becomes the difficulty of obtaining absolute cleanliness, and the greater is the danger of noxious substances being carried from one patient to another.

The exciting cause of puerperal infection is, as we have seen, the introduction of certain microbes into the body of the woman, as a rule into her genital tract.

Sources of the Poison.—The infection may come from a woman similarly affected, from suppurating or decaying tissues, from putrefying substances

within or without the body, and from zymotic diseases, especially erysipelas and diphtheria.

Contagion.—That the disease may be brought from one patient to another was discovered by Denman, and, while in America it was denied by the leading obstetricians of the day, Hodge and Meigs, nevertheless it was proved to be contagious by the masterly essay of Oliver Wendell Holmes, who so distinguished himself in another line that his merit as a physician is apt to be overlooked.[10]

Now-a-days the contagiousness of puerperal infection is universally admitted, and the only mooted point is whether it is essential that the microbes be carried from one patient to another on solid objects or whether they may float through the air—a point to which we shall presently return.

Suppuration.—That the source of puerperal infection may be suppuration was pointed out as early as 1847 by Semmelweiss.[11] Students who had examined a patient with a cancerous ulcer of the uterus caused puerperal fever in and death to fourteen women.

In America was the celebrated case of Dr. Rutter of Philadelphia, who in 1843 had forty-three cases of puerperal septicemia in his practice, while neighboring practitioners had none. He bathed, changed his clothes, shaved off his hair and wore a wig, stayed ten days away from the city, and did not take with him to his next patient anything he had before worn or carried. She had an easy confinement, yet she died from puerperal fever. The great Meigs taught his students that such a fatality was God's providence.[12] It remained for the present generation to find the solution of the riddle in the fact revealed by a contemporary of Dr. Rutter, that he suffered from an obstinate muco-purulent coryza.[13] It is easy to understand now how by touching his nose with his fingers Dr. Rutter brought staphylococci and streptococci into the vagina or the uterus of his unfortunate patients.

A French physician who had delivered eight hundred women without accident was seized with suppurative adenitis, for which he wore a drainage-tube. Within three weeks he had three cases of puerperal septicemia.[14] During the time of the great morbidity and mortality in the New York Maternity Hospital immediately preceding the new era an assistant suffered frequently from pustulous eczema of the hands. A dentist, Dr. Pedley, called attention to decayed teeth in doctors and nurses as a possible source of puerperal infection.[15]

In 1889 there was in the New York Maternity Hospital a paralytic patient having a carbuncle in the sacral region. There were two puerperæ in the same ward, and all were in the hands of the same nurse. One of the two puerperæ, who had been perfectly well up to the eighth day after her confinement, got a chill and her temperature rose to 105.6° F. On the cervix was found a diphtheritic infiltration. The patient with the carbuncle had no puerperal affection of any kind.

Putrefaction.—Semmelweis showed conclusively that the enormous mortality prevalent in the lying-in hospital of Vienna was due to cadaver-poison

brought by the students from the dissecting-room to the wards in which women were examined and delivered. The hospital has two departments, one for students and one for midwives, admission taking place to each department on alternate days. Nevertheless, the mortality in the students' department was three times higher than that in the midwives' department. A similar instance is reported from private practice. A Scotch physician, Dr. Renton, and a friend practised in the same place. During a so-called "epidemic" of puerperal fever all Renton's patients remained healthy, while all those of his friend were taken sick. The difference between the two was owing to the fact that Renton did not, while his friend did, perform autopsies.[16]

The infection may originate also from a decomposing part of a living body. Thus, frequently pieces of placenta or of membranes, left behind in the uterus, become the starting-point of puerperal infection. The writer once had a patient who gave birth to a macerated fetus, and from whose uterus a decomposed placenta was removed without doing the least harm to the parturient, but it gave rise in another patient to one of the worst cases of puerperal infection in the writer's experience. The assistant who delivered the first woman was allowed by his colleague in charge of the second to examine her, and, although he disinfected his hands with bichlorid, he doubtless brought on his fingers the germs that came near costing the woman her life.

Some years prior to the date of the writer's connection with the New York Maternity Hospital there was erected on Blackwell's Island, N. Y., a new building designed as a maternity hospital. The building had scarcely been opened before such a so-called "epidemic" of puerperal fever broke out in it that it had to be vacated. The cause of this epidemic was probably due to the manure with which the surrounding grounds had been covered in order to make a garden.

Fehling[17] observed an epidemic of puerperal fever, diphtheria, and erysipelas as the consequence of a bursted waste-pipe, the dirty water soaking into the ground on which stood the hospital.

Gustav Braun[18] in 1889 had so serious an epidemic in the Vienna lying-in hospital that during one month nearly 18 per cent. of the puerperæ were taken sick, and nearly 9 per cent. died. He attributed the trouble to the fecal matter from the hospital and that of a neighboring barrack being evacuated into a canal flowing past the hospital.

The immediate contiguity of a churchyard, a dunghill, a privy, a stable, a slaughter-house, a cess-pool, a sewer, a pool of dirty stagnant water, or similar places where organic substances are undergoing decomposition, is therefore dangerous to a parturient woman.

Zymotic Diseases.—The exact relations between puerperal infection and zymotic diseases are not definitely settled. Since it is now known that the streptococcus found in erysipelas is identical with that causing puerperal infection, there can hardly longer be entertained any doubt of the possibility

of puerperal infection being due to the poison brought to a puerpera from a person affected with erysipelas. The same observation applies probably to diphtheria, since a diphtheritic local affection entirely like that which occasionally develops in a wound, and which commonly appears in the upper air-passages in diphtheria, is one of the commonest forms of puerperal infection, and, as stated above, sometimes the specific Klebs-Löffler bacillus of diphtheria has been found in the exudation covering tears in the genital tract.

Scarlet fever may attack a puerpera, but it remains scarlet fever and follows a similar course to that in other patients. Typhoid fever is so well characterized by the intestinal ulcers and a specific microbe and is so different from puerperal infection that the two must be distinct diseases.

Ways by which the Poison enters the Body.—In the vast majority of cases the poison causing puerperal infection is brought mechanically into the genital tract by the fingers or by the instruments of doctors, midwives, or nurses. It may lurk in a lubricant or may adhere to a sponge, a rag, or to any other substance coming in contact with the genitals.

Many think that this mode of entrance is the only one, and deny infection through the air—a view which, in the writer's opinion, is contrary to many well-authenticated facts. There have already been quoted on the preceding page instances where epidemics in hospitals could only be traced to the ground, the walls of a building, or the air near it being infected by fecal matter and other refuse. Now, it does not seem at all likely that the doctors and nurses brought the microbes from the manure lying on the ground outside the new hospital on Blackwell's Island referred to, or from the feces floating in the canal flowing past the Vienna hospital, or from the wet ground that was soaked by the bursted waste-pipe described by Fehling. It is certainly more probable that the streptococci were carried through the air into the hospitals and were deposited on clothing, instruments, dressing-materials, or even on the hands of the physicians and nurses.

Some years ago there was in the New York Infant Asylum a local epidemic of puerperal infection, the cause of which was found to be a dead rat in the cellar. The doctors and nurses never visited the cellar, and the fireman who attended to the furnace there never entered the wards. Is it not, then, a logical conclusion that the microbes developed in the dead body of the rat were carried by the air of the cellar from floor to floor through the whole building? This method of dissemination is so much more likely as we have exact observations showing the existence of the streptococci in the air. Bumm [19] found the cocci in the dust floating in the air.

Depaul [20] reported the case of a pupil-midwife who, while washing the genitals of a patient affected with puerperal fever, felt an unpleasant sensation, was taken sick in the evening, and died on the third day "with all the symptoms of the most characteristic puerperal fever." The diagnosis of puerperal fever was confirmed by the autopsy; she was found also to be a virgin and not menstruating. The natural inference is that she inhaled through the lungs

the poison that caused her death. Credé[21] has shown that puerperal infection in children may start from the mouth.

The theory of air-infection in a limited space is also borne out by the effect of sanitary measures. Before the present system of antiseptic midwifery in the New York Maternity Hospital was practised, patients were always free from fever during the first week after a ward had been fumigated with sulphur. Busch[22] found that he prevented puerperal fever in the Berlin lying-in hospital by heating the wards before using them to 60° Réaumur (= 167° F.). In many hospitals a great improvement was obtained in the rate of mortality simply by introducing a better system of ventilation.

The writer firmly believes, therefore, in the possibility of the transmission of the morbific agent in puerperal infection through the air, but this applies only to closed rooms or to short distances. The atmosphere in general is not contaminated, and epidemics, in the old sense of the word, do not exist. They can always be traced to an individual carrier or to the neighborhood of a focus from which the disease spreads.

Autoinfection.—Some divide puerperal infection, in regard to its origin, into two classes, called *auto-genetic* and *hetero-genetic*. In the first class the puerpera is supposed to infect herself; in the second the infection is brought to her from without. According to some of the most modern bacteriologists, autoinfection is only possible as sapremia.[23] They maintain that the pathogenic cocci are never found in the healthy vagina nor in the healthy cervix.[24] Döderlein thinks that streptococci brought into the vagina soon disappear, just as he proved it experimentally for staphylococci. But other authorities[25] claim to have found both streptococci and staphylococci in the vaginæ of healthy pregnant and puerperal women. When we take into consideration that at least staphylococcus pyogenes abounds on human hands,[26] it can hardly be doubted that it is found also on the skin of the penis. Since, now, women often have sexual intercourse up to the day of their confinement, there is no difficulty in supposing that they have, at the time of their confinement, such cocci in the vagina, and that, in a certain sense, they may infect themselves, not only with saprophytes, but also with pathogenic cocci. Furthermore, puerperal infection may be due to diseased uterine appendages, or since a woman always has numerous saprophytes, and sometimes pathogenic cocci, in her vagina, these organisms may be carried hence by a perfectly disinfected finger into the uterus and cause infection, which in a certain sense is also an autoinfection.

When first we saw the wonderful effect of preventive antiseptic midwifery, we were inclined to throw all the blame for cases of infection on doctors and midwives. But abundant evidence has been preferred to prove that a woman in different ways may infect herself. Ahlfeldt * has collected 23 cases of death from puerperal fever in persons on whom no vaginal examination had been made. The autopsy revealed the cause of infection to be the retention of placental remains, old purulent collections, or latent gonorrhea.

* *Centralbl. f. Gynäk.*, 1899, p. 1195.

Czemetschka * has reported a case where the starting-point was a purulent rhinitis, which gave rise to pneumonia and purulent meningitis, and subsequently to metrolymphangitis. Diplococcus lanceolatus and diplococcus pneumoniæ were the only microbes found, and while the diplococcus lanceolatus was encapsulated in the lungs, it had no capsule in the lymph-vessels of the uterus. Such a case shows that the infection may have its source in the body of the patient herself, but in another sense, so far as the genitals are concerned, it may be looked upon as belonging to the class of heterogenetic infection.

In other cases infection is due to bacterium coli commune, which is found in every intestine and urethra, from which places it may invade the genital tract.†

Another most dangerous microbe, the bacillus emphysematosus, is constantly found in the human intestines. In the vagina it is the cause of emphysematous colpitis, or colpohyperplasia cystica. In the uterus it produces physometra. In general surgery it is the cause of the most dangerous wound disease, acute septic gangrene, to which in the puerperal woman is found an analogy in septic emphysema.‡

We must also remember that few vaginæ are absolutely healthy. It is claimed[27] that normal vaginal secretion contains only *Bacillus vaginalis* and *Oïdium albicans*, but as soon as the secretion becomes alkaline—which it easily does by admixture of cervical secretion—saprophytes, pyogenic staphylococci, and streptococci find a favorable soil, and autoinfection becomes possible.

Time of Infection.—Infection commonly takes place during delivery, but it may occur both before and after.

Mortality.—Puerperal infection is one of the most important of diseases. Before the introduction of antiseptic treatment puerperal infection often prevailed in so-called "epidemics," of which, according to Fordyce Barker,[28] more than two hundred had been described since 1740; independently of such periods of a conglomeration of fatalities the number of those carried off by the disease was and is very large. In the magnificent Lariboisière Hospital in Paris the mortality used to be almost 8 per cent. of all the women delivered.[29] In one of the services of the large lying-in hospital in Vienna the mortality for six years (1841–46) was almost 10 per cent.[30] In the Maternity Hospital of Paris it averaged during five years (1860–64) 11 per cent.[31] During seventeen years (1861–77) there was in Berlin one death from "puerperal fever" in every 178 confinements, or 0.57 per cent., and a total mortality in childbed of 1 in 152, or 0.65 per cent. Outside the capital the mortality was much greater. In all Prussia there died during sixty years (1816–75) 0.8 per cent. of all confined women, or, more exactly, 8322 out of every 1,000,000.[32]

Influence of Antisepsis on Mortality.—The above very important and con-

* *Centralbl. f. Gynäk.*, 1895, p. 231.

† Schenk, *Centralbl. f. Gynäk.*, 1898, p. 980.

‡ Lindenthal, *Centralbl. f. Gynäk.*, 1899, p. 679.

vincing statistical researches have been continued, and they show an improvement, which generally is attributed to the obligatory use of antiseptic drugs in the management of confinement cases. Thus the puerperal mortality from all causes was in Prussia during the eleven years following 1875 (1876–86) 0.5833 per cent., an improvement of 27.5 per cent.[33] Limiting the investigation to the child-bearing age (fifteen to forty-five), the mortality from "puerperal fever" was in the first period (1816–75) 12.01 per cent., and in the second (1876–86) 9.97 per cent., an improvement of 16.9 per cent.

Similar investigations in Denmark lead almost exactly to the same results, both as to the great mortality and to the improvement since the introduction of antiseptic precautions.[34] Still, with the sole exception of tuberculosis, "puerperal fever" is the most fatal disease for women between fifteen and forty-five years of age, and if we take the period of ten years between twenty-five and thirty-five years of age, in which most children are born, one death in every six is due to "puerperal fever." In the grand-duchy of Baden, however, the puerperal mortality has remained the same during the last forty years—a circumstance which is accounted for by the inefficiency of the midwives, who do as much harm as good by their way of using antisepsis.[35]

Pathology.—A peculiar feature of puerperal infection is the great diversity of the pathological changes—a circumstance that has given rise to much perplexity, but which can easily be accounted for, since it is known that the true agents at work are living organisms or a poison produced by them.

Vulvitis, or Aidoitis, and Vaginitis, or Colpitis.*—The external genitals may be the seat of a *catarrhal* or of a *diphtheritic* inflammation. In the catarrhal form the mucous membrane is swollen and red, and it secretes a muco-purulent fluid. In the diphtheritic form small whitish or yellowish false membranes appear, spread, and join one another until there is formed a more or less thick and large patch intimately connected with the surrounding tissue, which is swollen, infiltrated with serum, and of a dirty greenish or a brownish color.

Endometritis.—The endometrium is the chief point from which infection spreads throughout the body. The endometrium may be the seat of a catarrhal inflammation, when it is red, swollen, covered with a purulent fluid, and sometimes studded with small round pustules. The lips of the os are swollen and covered with granulations that easily bleed. Other forms of endometritis soon implicate the deeper layers of the uterus, and need no special description apart from that to be given under *Metritis*.

Metritis.—Metritis may assume four different forms—the simple, the diphtheritic, the dissecting, and the putrescent.

Simple Metritis.—In the simple form the uterus is much enlarged, its walls are thick, the tissue is soft and friable, and near the inner surface almost diffluent, cherry-colored, and bathed in a dirty greenish-brown fluid. Real ab-

* Aïdoitis is derived from *aidoion*, vulva; colpitis from κόλπος, gulf, the Greek name for vagina.

scesses may form in the wall, the pus of which may become inspissated or be evacuated by rupture. The cervix is often torn or bruised.

Diphtheritic metritis is characterized by a condition similar to that just described in the external genitals. As a rule, the process begins in the cervix. It may, however, also begin at the uterine ostium of the tube, and spread through the wall as a yellow layer out to the peritoneal coat of the uterus.

Dissecting metritis (Fig. 129) is a form that has been little heeded.* In this form a large piece of the muscular tissue of the uterus is severed from its surroundings, and is expelled sometimes so long as seven weeks after confinement.

Putrescent Metritis.—In the putrescent form the walls of the uterus are so thin that they show impressions of the intestine. The uterus is large. The mucous membrane of the interior hangs in discolored shreds, or it is easily movable over the subjacent tissue. The submucous connective tissue may be changed to a whitish mass, and the muscular tissue may be red and flabby; but sometimes the destruction extends deep into the muscular tissue, forming irregular cavities filled with a chocolate-colored or a black pulp, due to *acute inflammatory* or *acute septic gangrene*, or with a more ichorous or purulent fluid. It is particularly the placental site which is affected by this deep burrowing, the pathogenic microbes finding a favorable soil in the thrombi closing the veins. In other cases the infection follows the lymphatic vessels.

Fig. 129.—Dissecting metritis (Garrigues): specimen expelled by B. R—— at the New York Maternity Hospital on Oct. 20, 1883, the twenty-sixth day after confinement. This was the eighth case of the report published in the *New York Medical Record*, vol. xxiv. p. 664. (The figure, taken from a photograph, is two-thirds natural size.)

Salpingitis.—The Fallopian tubes are more rarely the road followed by the infecting microbes, but we may have both catarrhal and diphtheritic inflammation extending from the endometrium to this locality.

Oophoritis.—The ovaries very frequently are affected. We may find a superficial inflammation, the so-called *perioöphoritis*, combined with peritonitis, or *parenchymatous* oöphoritis, in which the deeper parts are inflamed, and which may end as an *ovarian abscess*, or a brownish, ichorous pulp (*putrescentia ovarii*).

Cellulitis.—The connective tissue of the pelvis and adjacent parts of the abdominal wall may be swollen, be infiltrated with serous fluid, full of small round cells, and be the seat of hemorrhagic thrombi. This inflammation may end in resolution or in suppuration, the abscess opening into the rectum, the vagina, and the bladder, or breaking through the skin, often after long wanderings, especially at Poupart's ligament or above the crest of the ilium. The inflammation may

* The writer has personally observed and described eight cases. He has given the affection its name, and was the first to point out its relation to the puerperal state (*New York Medical Journal*, 1882, vol. xxxvi. p. 587; *Archives of Medicine*, April, 1883; *Medical Record*, Dec., 1883, vol. xxiv. p. 664). A few cases have been added in Germany (see Hoechstenbach, *Archiv für Gynäkologie*, vol. xxxvii. p. 175).

even extend above the diaphragm and reach the posterior mediastinum. Or it may extend to the leg, causing the disease known as phlegmasia alba dolens. In rare cases it may follow the round ligament through the inguinal canal, and cause suppurative adenitis of the inguinal glands. It may enter the lung and cause interstitial pneumonia. This tendency to extension of the inflammation in the connective tissue has caused Virchow to designate the condition as *erysipelas puerperale malignum internum.*

Lymphangitis.—The lymphatic spaces and vessels are the chief roads by which puerperal infection reaches the deeper parts. Those of the vulva and the lower third of the vagina lead to the superficial inguinal glands, from

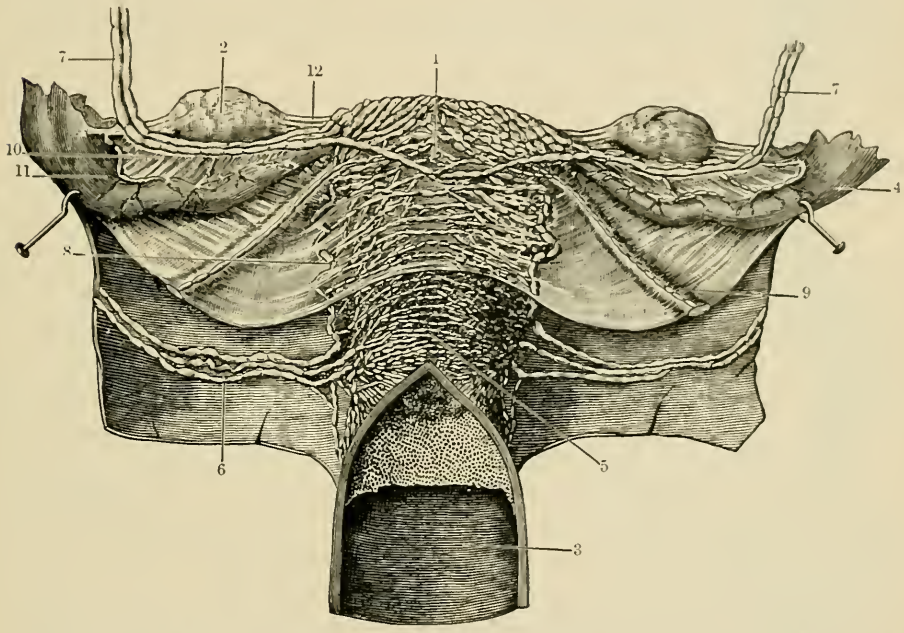


FIG. 130.—Lymphatics of the uterus: 1, lymphatics from the body and fundus of the uterus; 2, ovary; 3, vagina; 4, Fallopian tube; 5, lymphatics from the cervix; 6, lymphatic vessels from the cervix going to the iliac ganglia; 7, lymphatic vessels from the body and fundus going to the lumbar ganglia; 8, anastomoses of cervical and uterine vessels; 9, small lymphatic vessel in the round ligament going to the inguinal glands; 10, 11, lymphatic vessels of the tubes which empty into the large lymphatic vessels from the body of the uterus; 12, ovarian ligament (Poirier).

which others go to the deep inguinal glands, which again are in connection with the external iliac glands. Thus a neglected wound on the labium may become the starting-point of a general peritonitis.

From the upper two-thirds of the vagina and the cervix the lymphatics go to the internal iliac and the sacral glands. The uterus itself is a network of lymph-spaces and lymph-vessels, which finally lead to the lumbar glands (Fig. 130). While the lymph-vessels, normally, are so small as to be invisible when not injected, in puerperal lymphangitis they become as thick as a goose-quill, and they may form prominences on the surface of the uterus as large as cherries and filled with a purulent fluid. From the finer lymph-vessels the infection extends to the surrounding connective tissue.

Peritonitis.—Peritonitis is the most common affection in the graver cases of puerperal infection. The abdomen is swollen, the intestines being distended with gases. The inflammation may be *local*—that is, limited to the pelvis—or be *diffuse*, extending over more or less of the abdomen; it may be *adhesive* or be *purulent*. The peritoneum is injected; its endothelium is thrown off, and it is in places covered with plastic lymph, which binds the knuckles of the intestines together or to the other pelvic and abdominal organs. In the peritoneal cavity is found a fluid that may be serous, fibrinous, or purulent. There may be as much as one or two quarts of it. Often this fluid very much resembles milk, and contains large clots like curdled milk. In other cases it is brown, thin, and offensive. The inflammation starts in most cases from the endometrium and spreads through the lymphatics.

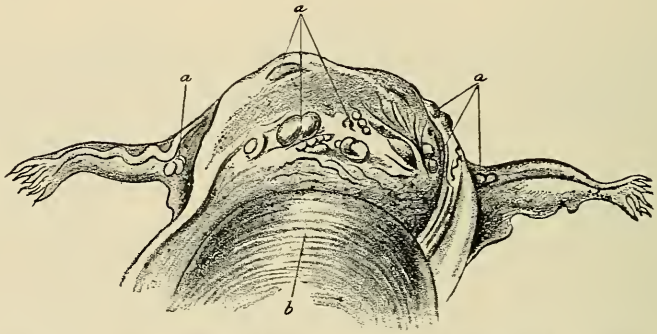


FIG. 131.—*a*, *a*, *a*, swollen lymphatics on anterior surface of uterus; *b*, bladder.

Pleurisy and Pericarditis.—From the peritoneum the microbes find easy access, through the stomata of the diaphragm, into the lymphatics of the pleura and the pericardium, which become red, swollen, and injected, are covered with false membranes, and contain a sero-purulent fluid.

Phlebitis.—The veins also often offer, as has been noted, roads for the microbes to enter the system, although less frequently than do the lymph-vessels. Phlebitis occurs in the uterus or in the lower extremity.

Uterine Phlebitis.—As we have stated, the thrombi (Fig. 132) that form in the uterine sinuses, when the contraction and retraction are imperfect, are a fertile soil for pathogenic germs. From the sinuses of the uterus the thrombosis may extend more or less into the uterine and other veins. The thrombus may become tunnelled, so that the vessel regains its lumen, or it may become organized into connective tissue and form a permanent plug. A piece of the thrombus may be torn off and be carried far away by the blood current, forming an embolus, or the thrombus may become disintegrated and be liquefied to a puriform fluid which mixes with the blood and causes the condition known as *pyemia*. In this way the microbes may be carried throughout the body, forming new foci of disease in all organs. Thus infarctions appear in the lungs and lead to pneumonia and to pulmonary abscesses. The posterior part of the lungs is often the seat of hypostatic pneumonia. The

spleen, which is large and soft, may contain infarctions, but these rarely suppurate.

The kidneys are the seat of hyperemia and infarctions, the latter often forming abscesses. In cases with a more chronic course amyloid degeneration may set in. Sometimes the loose connective tissue around the kidneys is inflamed, and there may form a perinephritic abscess. The liver may become the seat of hepatitis and hepatic abscesses. The mucous membrane of the intestines is swollen, but no ulcers form. The heart is frequently affected by endocarditis, often of the ulcerous variety, by myocarditis, or by pericarditis.

FIG. 132.—Clots in sinuses of uterine walls (from specimen in the Army Medical Museum, Washington, D. C.).

The eyes may be destroyed. The brain and its meninges are rarely inflamed. The breasts, the parotids, the tonsils, and the thyroid body may become inflamed and suppurate. In the bladder are sometimes formed ulcerations. On the skin appear erythematous, erysipelatous, vesicular, or pustular eruptions. The articulations are often affected, and they may fall a prey to pyarthrosis, ending in ankylosis. The subcutaneous and intermuscular connective tissue may be infiltrated extensively with pus, and form large shreds of mortified tissue.

Phlebitis of the Leg.—The disease known as *phlegmasia alba dolens* may be due either to phlebitis or to cellulitis. Often both conditions are combined. It begins always at the upper part of the thigh, and the name should not be used to designate a simple marantic thrombosis in the calf or the lower part of the thigh. Phlegmasia may be a continuation of phlebitis of the iliac and ovarian veins. In some cases the inflammation of the vein may be secondary to thrombosis, and may again lead to periphlebitis and cellulitis. In other instances the process takes an inverse course, the inflammation of the connective tissue leading to phlebitis and thrombosis. The thrombi are subject to the same changes as stated above. In the phlebitic form one or more veins form solid strings, and below the obstruction the extremity becomes edematous and swollen. In the cellulitic form the skin is white or pink, tense, and hard; one or both legs swell, and the epidermis may be lifted by a serous fluid, forming large vesicles. The inguinal glands swell. Suppuration and mortification may spread destruction in the connective tissue under the skin or between the muscles. This pernicious form, however, is rare.

Sometimes *gas* is formed in many organs, especially the liver and the cavity of the uterus—so-called *tympania uteri*. This production of gas is generally due to the presence of *bacillus aërogenes capsulatus*.

Acutest Septicemia.—In the severest cases of puerperal infection the above-mentioned inflammations hardly have time to develop before the patient

succumbs. Still, there are traces of lymphangitis or phlebitis of the uterus, swelling of the connective tissue, and a little bloody fluid in different cavities; the glandular organs of the abdomen are large, soft, and friable, the microscope showing their cells to be in the condition called "cloudy swelling;" the blood is dark, thin, and only slightly coagulable.

Symptoms, Diagnosis, and Prognosis.—In treating a case of puerperal infection one would first like to know if he has to deal with pathogenic or with non-pathogenic bacteria. In some particularly well-appointed clinics an expert bacteriologist makes daily microscopical examinations and pure cultures, but most physicians have to form an opinion by the phenomena observed in the patient herself. In this respect three points are of great importance, namely: If the infection is caused by pathogenic microbes, the disease begins earlier, perhaps within a few hours after delivery, and certainly within a few days; the general condition of the patient suffers much more, and she soon becomes somnolent; and, finally, the frequent, weak pulse and the high temperature bear witness to the presence of higher fever. But even an infection that begins as non-pathogenic, or a condition that originally is not caused by infection at all—for instance, a marantic thrombosis—may later change in character and end in sepsis.

Some groups of cases are so well marked in many respects that it facilitates the description to point them out. Thus there are *localized* cases, where the disturbances are limited to the genital canal and hardly affect the system in general. There is a *lymphatic* form, in which the invasion takes place through the lymph-vessels, and which begins early and implicates the serous membranes, causing peritonitis, pleurisy, and pericarditis. There is a *phlebitic* form, in which the microbes enter through the thrombi in the uterine sinuses. The latter form begins later, progresses more slowly than the preceding form, and it is characterized by repeated chills and metastases in remote organs. Finally, there are cases of *acutest septicemia*, in which the patient succumbs before the usual inflammations are well developed. But all cases cannot be divided into these groups: sometimes two forms are combined, such as lymphangitis and phlebitis; and often one passes into the other, as when an affection seemingly local in the course of its development ends by becoming generalized. The writer prefers, therefore, to follow the anatomical distribution, and to describe the symptoms observed in each organ, adding remarks in regard to diagnosis and prognosis as he progresses from one to another.

Aïdoitis and Colpitis.—*Symptoms.*—In the *catarrhal* form of aïdoitis and colpitis micturition is accompanied by a burning sensation.

The *ulcerative* form causes a slight rise in temperature. The labia are swollen and tender, and the ulcers being slow to heal, the process of reparation may require as much as three weeks. The lochia are often fetid; the patient complains of smarting when she urinates, and sometimes she suffers from retention of urine.

The *diphtheritic* form is much more serious. It begins often with a chill, followed by high temperature, which may reach 107° F. This fever

begins generally from two to four days after delivery. It has no typical temperature-curve, except that there is a rise every evening. The pulse is rapid and weak, and the respiration is accelerated. The patient has no appetite, the tongue is coated, the bowels are often loose, and she is frequently troubled with nausea and vomiting.

As a rule, the uterus is implicated. It is large and tender, and the lochia become scanty, grayish, and offensive. The secretion of milk does not begin or it ceases. The patient complains of pain in the hypogastric region, sometimes extending down to the legs. She has severe headache, and soon becomes stupid and delirious. These signs of general disturbance may precede the appearance of the diphtheritic exudation. For several days new patches form and the old ulcers spread. From the time the infiltration ceases until the scabs produced by the treatment recommended below are cast off and the sores healed about a week elapses. The labia are swollen and are covered with the above-described patches. Erythema or erysipelas may start from them and spread more or less over the body. Sometimes the tissues become gangrenous. Cicatrices may cause considerable shortening and narrowing of the vagina.

Diagnosis.—With a little care diphtheritic ulcers cannot be confounded with pus-covered tears in healthy tissue. These tears give rise to no general or local disturbance.

Prognosis.—In the catarrhal and ulcerative forms of aïdoitis the prognosis is good. The diphtheritic form, however, shows considerable mortality.*

Endometritis and Metritis.—*Symptoms.*—The *simple* form of metritis is characterized by moderate fever, often beginning with a chilly sensation; some pain, especially severe after-pains; headache, anorexia, and a coated tongue. The lochial discharge is fetid, continues red longer than usual, or becomes so again after having been yellow. The uterus is enlarged and tender. In regard to the *diphtheritic* form the reader is referred to what has been said above under *Aïdoitis.* The diagnosis of streptococcic endometritis is based on bacteriology, but if it is known that portions of the placenta or the membranes have been retained, the presence of streptococci is probable. A fetid discharge is not characteristic. It may be due to saprophytes in the uterus or in the vagina, and, on the other hand, all fetor may be absent in serious cases of infection. *Dissecting* metritis (Fig. 129) gives rise, as a rule, to a protracted purulent discharge. The *putrescent* form shows symptoms similar to those found in the most severe diphtheritic cases, and it is accompanied by a particularly offensive discharge.

Prognosis.—In the simple form of metritis the prognosis is good. The disease lasts a week or two. In the diphtheritic form the prognosis is doubtful, the disease often ending fatally. The dissecting form has a better prognosis.† The putrescent form is nearly always fatal.

* Of 27 cases of puerperal diphtheria, forming the base of a paper[36] by the writer, five died.

† Of 14 cases known, three ended fatally. Of the writer's 8 cases only one died, which death was due to rupture of the uterus in consequence of an error committed by an assistant.

Salpingitis and Oophoritis.—These affections appear only together with endometritis or peritonitis, and their symptoms are merged in those of the inflammation of the uterus or of the peritoneum.

Cellulitis, or Parametritis.—The inflammation of the pelvic connective tissue begins generally on the fourth day, rarely as early as the second or as late as the eighth. It commences with a chill or a chilly sensation, followed by fever, anorexia, weakness, and headache. The temperature rises, the pulse and the respiration become more frequent, the patient complains of pain at the side of the uterus, and by bimanual examination we find the fornix of the vagina tender and a swelling extending from it in the direction of the iliac fossa. When the swelling increases, it pushes the uterus over to the opposite side. As a rule, only one side is affected, but sometimes a similar condition is found on both sides. The uterus is hardly movable. Severe neuralgic pains may extend down the lower extremities or up to the lumbar region, which condition may be due to simple pressure on the nerve-trunks in the pelvis or to an implication of the nerves in the inflammation. If the inflammation attacks the connective tissue of the iliac fossa, the corresponding extremity is drawn up and adducted, so that the affected knee rests on the other extremity. The extremity swells and becomes edematous. Sometimes thrombi may be felt in the veins of Scarpa's triangle, of the popliteal space, or of the calf.

Usually the inflammation ends in resolution. If pus forms, the patient has repeated chills, the swelling becomes softer, and, finally, fluctuation may be felt. The pus may be evacuated through one of the hollow organs—vagina, rectum, or bladder—or may break through the skin in more or less remote places, especially near Poupart's ligament or at the crest of the ilium. The abscess may now close; but often suppuration goes on, especially if the abscess-cavity communicates with the intestine, and, finally, the patient may die from exhaustion. In very rare cases the abscess ruptures into the peritoneal cavity, causing diffuse and speedily fatal peritonitis.

Diagnosis.—It may be difficult to decide whether an exudation begins in the connective tissue or in the peritoneal cavity. Cellulitis nearly always starts from a torn cervix. The swelling is found on the side of the uterus, not behind, or, if so found, then only as a comparatively thin projection or bridge. When it reaches the pelvic wall it follows the latter closely, while in peritonitis the fingers may be inserted between the swelling and the bones. If the inflammation spreads in cellulitis, it often goes down on the side of the vagina to the vulva; a peritonitic exudation can only increase in the direction of the other side or upward, and it implicates, as a rule, Douglas's pouch, pushing the uterus forward.

Prognosis.—As a rule, the prognosis is good. Generally, the process ends in resolution within two weeks. But it may be very protracted, even without suppuration. If an abscess is formed, the prognosis as to life and duration is less good, but even then with proper treatment the patient generally recovers. Rupture into the peritoneal cavity is fatal, unless laparotomy is per-

formed. If cellulitis appears as part of the general infection, the result is very doubtful.

Lymphangitis.—Lymphangitis may start from the vulva and the lower part of the vagina or from the uterus.

Vulvar lymphangitis is of little importance if it is arrested at the superficial inguinal glands. The patient presents the usual fever-symptoms, and red lines may be seen on the skin extending from the vulva to the groin. The labia swell and smart. The glands very rarely suppurate. If the inflammation implicates the deeper inguinal glands, it may lead to peritonitis.

Uterine lymphangitis (Fig. 130) is the most common beginning of general puerperal infection, but it may also continue as a local process. The patient shows the usual fever-symptoms. The uterus is enlarged and tender, especially near the cornua. The pulse is full. There may be a little vomiting and some tympanites.

Diagnosis.—Uterine lymphangitis differs from cellulitis and local peritonitis in the absence of swelling at the vaginal roof; from diffuse peritonitis in the limitation to the lower part of the abdomen, the full pulse, and the absence of green vomit.

Peritonitis.—On account of the difference in the severity of the symptoms and the progress it is expedient to consider *local* and *diffuse* peritonitis separately.

Local peritonitis, like the other localizations hitherto described, begins with a chill, but this is much more protracted, lasting from ten to twenty minutes, and it is accompanied or is followed by a peculiarly intense pain in the lower part of the abdomen, which is extremely tender to the touch. The temperature rises suddenly to 103° or 104° F. The pulse beats from 100 to 120 times per minute, and it is small and hard. The respiration is rapid. The fever is continuous, with an exacerbation toward night. The patient has no appetite, but has an unquenchable thirst. The tongue is coated. The bowels, at first constipated, later become loose. There is usually some vomiting of food, mucus, and bile, and sometimes moderate hiccough. The lower half of the abdomen is distended, and in order to lessen the tension the patient lies on her back and draws up her knees. The secretion of milk is normal or is scant. The lochial discharge is diminished, is of a dirty color, and often is of offensive odor.

In the course of a week or two a distinct tumor is felt in the pelvis and the lower part of the abdomen, which tumor is composed of the uterus, the appendages, the intestine, the omentum,—all matted together with exudation and new-formed adhesions. Below, the exudation is usually situated in Douglas's pouch, pushing the uterus forward, but it may also be placed more laterally, pressing the uterus over to the other side, and at the same time canting it forward. The exudation pushes the fornix of the vagina in front of it, so that the cervix seems to disappear, and together with the corpus uteri it forms a pear-shaped body, without distinction between the two. The abdominal surface of the swelling is uneven, and it offers a different degree of resistance in different parts. Often

a peculiar sensation, much like that experienced in pressing a snowball, is felt on slight pressure. It is due to fresh adhesions being torn, as can be inferred from what we find in laparotomies performed after this crepitation has been felt.

The swelling usually ends in resolution in the course of two or three weeks. Pain, fever, and swelling subside and the patient gradually regains her health. But the swelling may end also in suppuration, in which event the fever increases; the patient has repeated chills; the swelling softens and becomes boggy, and sometimes fluctuating. If the abscess tends toward the vagina, fluctuation may be felt here. If it progresses to the bladder, the patient feels a frequent desire to empty this organ, and the act of micturition is more or less painful. If the rectum is being implicated, the patient complains of tenesmus. Wherever the abscess breaks a large amount of offensive pus, mixed with grumous masses, is evacuated. The most common, and at the same time the most fortunate, place of evacuation is through the vagina. In some cases the abscess after breaking may close at once, but in other cases, especially if there is a communication with the rectum, it may refill, or, if the pus is found in separate foci, the process of elimination may be very protracted and exhaust the patient's strength. The pus may also follow the vagina downward and open in the ischio-rectal fossa. Enteritis, cystitis, or pyelo-nephritis may develop.

Prognosis.—As a rule, local peritonitis ends in recovery, but it may become diffuse and speedily end the patient's life, or it may take so protracted a course that she succumbs to exhaustion. As to complete restoration to health, the prognostication should be guarded. Peritonitis leaves a predisposition to new attacks. It often causes chronic oöphoritis and salpingitis, making the patient more or less an invalid, and it is a frequent cause of sterility; or, if she again conceives, she is more apt to have inflammatory trouble in subsequent confinements.

Diffuse peritonitis has symptoms similar to those of local peritonitis, but much intensified. It appears, as a rule, from two to four days after delivery, but it may also begin immediately after parturition. The chill lasts from half an hour to several hours. The pain is excruciating, and it spreads over the entire abdomen. The pulse beats from 120 to 160 per minute. The temperature is 104° F. or higher. The respiration ranges from 26 to 56 per minute, and it is shallow on account of the pain produced by the movements of the diaphragm and on account of the compression of the lungs by the inflated intestine. The patient lies on her back, with the knees drawn up. She shuns every movement and dreads every approach. Even the weight of the bedclothes may be intolerable. Her face expresses the greatest anxiety and pain. Her features are pinched, the corners of her mouth drawn down; the eyes sink deep into their sockets, a black streak showing under each lower lid. The skin is pale; the tongue is dry, red at the point and the edges, and brown in the middle. The thirst is unquenchable. The patient vomits continuously, and the vomit soon has the peculiar appearance of chopped spinach. Commonly the patient has diarrhea, and is often racked by hiccough.

The urine, which is scant and often contains albumin, must frequently be drawn with a catheter. The milk-secretion soon ceases. The lochia are scant, often fetid, or disappear altogether. The abdomen is enormously distended; the percussion sound is tympanitic in front, dull at the dependent parts; and the pectoral organs are pushed up and compressed.

The patient often suffers from insomnia, and at the same time, as a rule, she is in a somnolent condition, is slow to answer questions, or is completely delirious. From her listless lethargy she suddenly starts up as if scared by appalling dreams and visions, and looks around with a pitiful expression of dismay and horror. In some cases the intellect remains clear to the last.

Prognosis.—Diffuse peritonitis is one of the most dangerous forms of puerperal infection, but the patient may recover. Favorable signs are the decrease in the frequency of the pulse and the respiration, the fall in temperature, the disappearance of pain, the cessation of tympanites and vomiting, the return of the appetite, the increase in strength, the return of mental clearness, and a cheerful disposition.

Unfavorable signs are an irregular pulse or one beating more than 140; a temperature above 104° F.; a laborious respiration, over 40; a copious diarrhea; cold, clammy extremities; the appearance of red blotches on the skin; a profuse perspiration; the subsidence of pain, while the distention of the abdomen remains the same or increases. Death occurs usually in nine or ten days, except where an abscess ruptures into the peritoneal cavity, when life becomes extinct in a day or two. What has been said above about the doubtful return to perfect health applies still more to diffuse peritonitis.

Pleurisy.—Pleurisy, as a rule, is secondary to peritonitis or to phlebitis, but it may be a primary lesion. The fluid is sero-purulent, like that in peritonitis, except when it is due to an infected embolus. In such cases the fluid is purulent. When pleurisy supervenes in the course of peritonitis it is easily overlooked—so much more so as, on account of the patient's sufferings, we often cannot make a physical examination. Its advent may be marked by a new chill, by increased fever, and by still more embarrassed respiration.

Prognosis.—Pleurisy is a very serious complication in childbed.

Pneumonia.—Pneumonia appears as hypostatic pneumonia in the most dependent part of the lungs or in disseminated foci due to embolism in any part of the organ. It is generally combined with pleurisy. The usual symptoms of the disease—pain, cough, bloody expectoration, and dyspnea—may be missing, when it can only be diagnosticated by the stethoscopic signs—crepitant râles, bronchial respiration, and dull or flat percussion-sound.

Prognosis.—Pneumonia is a dangerous affection in a puerpera.

Pericarditis.—Pericarditis may be propagated through the lymph-vessels of the diaphragm from peritonitis, or may be due to emboli from a venous thrombus.

The *symptoms* generally become merged into those of other inflammations. Sometimes, however, a friction-sound or an increased dull area reveals the presence of false membranes or of exudation around the heart.

Phlegmasia Alba Dolens.—The *thrombo-phlebitic form* of phlegmasia may begin during pregnancy, and is accompanied by fever and a sensation of heaviness in the limb. Commonly the inflammation begins in the second week after confinement. Sometimes the local affection is preceded by anorexia, a bad taste, a coated tongue, constipation, and eructations. The phlegmasia begins with fever and, perhaps, a chill. The urine is concentrated. The limb swells from above downward. The upper part of the thigh is first affected, but thence edema may spread all over the extremity. The limb is painful; the skin is white, tense, hard, sometimes covered with blisters, or it may become red and be perforated by an abscess. The affected veins may be felt as hard strings. Both extremities may be affected, the thrombosis passing from one side to the other through the vena cava, or beginning independently in either extremity. The phlegmasia usually runs its course in from three to six weeks, and ends in resolution. It may pass into suppuration and the patient still recover. Sometimes gangrene sets in and leads to death, or septicemia may develop.

Varicose veins are more liable to the formation of thrombi than healthy veins. If the deeper veins are affected, the skin has a peculiar purple color, which variety has been distinguished under the name of *phlegmasia cœrulea dolens.* As a rule, the thrombus is reabsorbed, and the swelling subsides. In other cases there forms a periphlebitic abscess that breaks on the skin; and in still others the thrombus may become infected and give rise to metastases just like those which will presently be described under *Uterine Phlebitis.*

The *cellulitic form* of phlegmasia is characterized by high fever, by considerable pain, by redness of the skin, by the appearance of bullæ, and by extensive suppuration and mortification of the subcutaneous and intramuscular connective tissue. Large shreds of connective tissue may be expelled and the sores heal, but there is great danger of the patient falling a prey to gangrene or to septicemia, or of being exhausted by the protracted suppuration.

Uterine Phlebitis, or Metrophlebitis.—The veins of the uterus may be blocked by simple thrombosis, which may extend more or less into the pelvis. If the iliac vein becomes implicated, phlegmasia alba dolens supervenes. If pathogenic microbes find their way into the uterine sinuses, there develops infectious uterine phlebitis or pyemia—one of the severest forms of puerperal infection.

Metrophlebitis often follows obstetric operations, especially such in which the hand is introduced into the uterus, as in version or the artificial removal of the placenta. It may be due also to retention of pieces of the placenta, to placenta prævia, to deep lacerations of the perineum, or carcinoma of the uterus or the vagina.

Uterine phlebitis begins with a long and severe chill, followed by similar attacks at irregular intervals, and it is characterized by metastases in one or more organs. The initial chill, as a rule, comes between the fifth and seventh day after confinement. The chills are due to the entrance into the blood of

microbes or of their chemical products. During the chills the temperature rises to from 104° to 108° F., the pulse beats from 140 to 160 per minute, the respiration becomes as frequent as from 36 to 56. Rarely the patient, instead of real chills, has only chilly sensations. In the interval between the chills, especially after the first chill, she feels great relief, the temperature sinking to 100° or 101° F., and the pulse and respiration becoming less frequent. In this form of puerperal infection there is no pain, little tenderness, and no tympanites.

After the lull of the first interval new chills follow, and the more metastases are developed the more the fever becomes continuous. The skin turns yellowish, and sometimes complete jaundice develops. The nose becomes pinched; the eyes lie deep; the cheeks are hollow; the tongue is dry and coated. The patient has no appetite, but has great thirst, headache, insomnia, sometimes diarrhea, and less frequently vomiting. Frequently the breath has a peculiarly disagreeable smell, designated as "sweet." The urine is scant, and it almost always contains albumin.

In light cases there may be only two or three chills in a week, and the patient may recover without localizations, and even in most of the severe cases no localization takes place.

The secondary infection appears first in the lungs, then in the pleura, the heart, the liver, the kidneys, the spleen, the intestine, the meninges, the brain, the eyes, muscle-sheaths, especially on the forearm, the articulations, the skin, and the connective tissue. Pneumonia, pleurisy, and pericarditis have already been described, and the other localizations will presently be noticed.

Diagnosis.—Uterine phlebitis in the beginning is somewhat like *malarial fever*, but the chills are repeated at irregular intervals and the fever soon becomes continuous. Swollen veins may be felt in the pelvis, and phlegmasia alba dolens may supervene. Sometimes there is metrorrhagia. The appearance of metastases is characteristic.

If adynamic and ataxic symptoms develop, the disease may be mistaken for *typhoid fever*. First of all, we must know if the patient is or is not a puerpera. If she denies having recently given birth to a child, it can easily be proved by the presence of milk in the breasts, by the flaccidity of the abdominal wall and the presence on it of purple-colored striæ, by the large size of the uterus, by tears in the cervix, in the vagina, or in the vulva, and by the presence of lochia.

Typhoid fever may develop in the puerperal state, but that is a very rare occurrence. It is characterized by the continuous fever, by ochre-colored stools, by tenderness on pressure in the right iliac fossa, and by the appearance of a few discrete, small pink spots on the abdomen. Visceral complications are rare, and at the end of the third week a decided change takes place for the better or the worse.

In uterine phlebitis there may be gargouillement, but no tenderness, in the right iliac fossa. There may be cutaneous eruptions, but they are spread over

larger surfaces as erysipelas, general erythema, large blotches, papules, or petechiæ. There is no regular fever-curve. The disease begins with very high temperature and a pronounced chill. The temperature then falls suddenly nearly to normal, to rise again with the next chill. Complications in different organs are a chief feature of the disease.

The distinction between uterine *lymphangitis* and phlebitis is more of scientific than of practical interest, and frequently the two are combined. Lymphangitis usually begins from two to five days after delivery; phlebitis usually begins at the end of the first week. In lymphangitis there is pain in the lower part of the abdomen; in phlebitis there is hardly any pain. In lymphangitis there is great tenderness on pressure; in phlebitis there is none of the abdomen and little in the pelvis. In lymphangitis the uterus is large; phlebitis has less influence on the involution. Lymphangitis spreads rapidly upward, and may cause peritonitis, pericarditis, pleurisy, hypostatic pneumonia; but it does not affect the head or the limbs nor cause pyemia with infarction and abscesses in the viscera. Lymphangitis may begin with a chill, but this is not so severe as in phlebitis, and it is not repeated. In lymphangitis the fever is more continuous; in phlebitis there are marked fever intermissions or remissions.

Endocarditis.—The inflammation of the endocardium may be found as the only localization of puerperal infection, without pyemia. Then it begins in the first days of the puerperium with an intense chill. The fever runs high, with slight remissions. Much less frequently it has an intermittent type. The central nervous system is much affected. The patient has headache, vertigo, and insomnia, alternating with harassing dreams. She is listless, weak, and delirious. She is in a stuporous condition, and talks in a murmuring way or sinks into deep coma. More rarely she may become maniacal. The muscles of the neck are contracted, she grinds her teeth, squints, enters into convulsions, or is paralyzed.

Hemorrhage often takes place into the retina, less frequently into the choroid or iris. The whole eye may be destroyed by suppuration. In the skin is also found extravasation of blood, roseola, a scarlatiniform or pemphigoid eruption. Sometimes the patient has diarrhea. The disease lasts from ten to twenty days or even four weeks.

When endocarditis occurs as part of metrophlebitis, it appears late in the puerperium—from ten to fifteen days after delivery. It is accompanied by an increase in fever and somnolence, and gives rise to a rasping sound, especially at the apex, more rarely at the base. This murmur is generally synchronous with the first heart-sound, but it may also be heard with the second. It shows a peculiar mobility, being heard one day at the apex, the next at the base, or *vice versa*, and it may be absent altogether.

Endocarditis is commonly ulcerous. When the small abscesses in the endocardium break, they empty their contents—pus, microbes, and their chemical products—into the blood-current, which carries them through the entire system, causing new localizations of the infection; but the symptoms of these

abscesses are so merged into those already present that they cannot be distinguished.

The *diagnosis* is based on the cerebral and ocular symptoms. Heart-sounds are unreliable. Murmurs may be heard without endocarditis and be absent with it. *Typhoid fever* is characterized by its typical fever-curve, the slight cutaneous eruption, the ochre-colored stools, and tenderness in the right iliac fossa.

In *uræmia* vomiting is a predominant symptom.

Etiology.—Women who have had inflammatory rheumatism which has left the cardiac valves rough and uneven are predisposed to puerperal endocarditis.

Pathology.—The left half of the heart is more affected than the right. The valves are thickened and covered with a deposit that cannot be scraped off. At the same time there is ulceration, with loss of substance in other places. In the wall of the heart are often found miliary abscesses, which may break and empty their contents into the blood-current. This exudation, the ulcers, and the abscesses are due to colonies of cocci.

A similar affection is more rarely found in the tricuspid valve and the pulmonary veins.

The kidneys often contain miliary abscesses. The dura and pia mater may be the seat of suppuration, and abscesses may be found in the brain.

The *prognosis* of endocarditis is bad, whether it is isolated or appears in metrophlebitis.

The **alimentary canal** does not suffer much in uterine phlebitis. We have, however, mentioned the complete anorexia, the unquenchable thirst, the profuse diarrhea, and the occasional vomiting. Sometimes thrush appears on the dry tongue. In rare cases abscesses are formed in the parotid, the tonsil, or the thyroid body, the appearance of which abscesses makes the prognosis still more unfavorable.

Hepatitis.—The liver is very frequently implicated in puerperal metrophlebitis. There is pain in the right hypochondrium. The organ is enlarged, as can be found by percussion and palpation, and it is tender on pressure. The skin has a yellow tint, and often real jaundice develops. The serous coat is often implicated in peritonitis, and then sometimes, on slight pressure, there can be felt the crepitation characteristic of new-formed adhesions.

Nephritis.—Inflammation of the kidneys, which is a very frequent occurrence, is characterized by the presence of albumin and casts in the urine, whereas the other symptoms, such as headache, somnolence, disturbed eyesight, vomiting, and pain in the lumbar region, are so covered by the general condition that they lose their diagnostic importance. An inflammation of the loose connective tissue in which the kidney is imbedded may cause constant tenderness on pressure in the lumbar region.

Splenitis.—An inflammation of the spleen may sometimes be diagnosticated by palpation and an increase in the normal dull area in the left hypochondrium. The patient may complain of pain and tenderness in this locality.

If an abscess ruptures into the peritoneal cavity, she collapses and dies. Generally the symptoms due to localization in the spleen are, however, so blended with those due to other localizations and the general condition that they are not recognizable.

Nervous Disturbances.—Manifold disturbances occur in the nervous system during the puerperal state, such as neuralgia, paralysis, convulsions, tetanus, tetany, insomnia, delirium, etc., and need not be due to infection, but to anemia or hyperemia of the brain, hysteria, pressure on a nerve-trunk, or a reflex action. Severe affections of the nervous system may be due, however, to thrombosis of the cerebral veins or to purulent meningitis, produced by metastasis from an infected endometrium.

Arthritis.—Sometimes the infecting agents in metro-phlebitis are carried to the joints. At the beginning many articulations may be affected, but while the inflammation subsides in most of them, it may remain in one or two, especially those of the knee, shoulder, or elbow. Of the articulations of the trunk, the symphysis pubis, the sacro-iliac, and the sterno-clavicular are most frequently affected.

Puerperal articular inflammation differs from rheumatic inflammation by its stability, and from both this and the gonorrheal type by its pronounced tendency to suppuration. The affected joints become painful, the pain being much increased by movements or by pressure. The skin becomes red and hot, and if there is an abscess in the articulation, the joint may be perforated. All the tissues composing the joint, even the cartilage and bone, may be destroyed. If the patient survives, the affected joint may remain ankylosed.

Abscess and Diffuse Cellulitis of the Limbs.—Both the subcutaneous and the intermuscular connective tissue may become the seat of localization of puerperal infection. The limb swells and is painful. The skin becomes red and hot. Circumscribed abscesses may form, or, especially in the subfascial form, a diffuse phlegmon may extend over a large area—a form which is very dangerous, and which may cost the patient her life or it may leave her in a crippled condition.

Skin Diseases.—A puerpera may, as well as another person, be attacked by eruptive fevers, such as measles, scarlet fever, small-pox, or erysipelas, as an accidental complication. She may likewise have some kind of eruption in consequence of the use of certain drugs—for example, copaiva, quinin salicylic acid, or iodoform.

A *miliary* eruption, consisting of small white vesicles, sometimes each surrounded by a red ring or springing from a red skin, is often found in an otherwise well woman, and is only due to increased perspiration. This eruption is generally found on the trunk. Sometimes an eruption of red maculæ or papulæ, or a general erythema, accompanied by more or less fever, appears on the skin in puerperæ who present no other sign of disease.

But in other cases the skin-eruption accompanies other symptoms of severe puerperal infection, and it must then be regarded as part of the infection. An *erythema* may spread more or less far from the genitals, or large erythematous

blotches may appear on any part of the body. Small dark hyperemic spots of the size of a hempseed—so-called *petechiæ*—that do not vanish on pressure, may appear in very severe, generally fatal, cases. Sometimes there is a *pemphigus-like* eruption, the epidermis being raised by a serous exudation, forming large vesicles. In other cases, again, *bullæ* filled with pus develop, rupture, and leave sores.

Finally, infected puerperæ are very liable to have *bed-sores*, especially on the sacrum and the heels. In all those cutaneous affections that appear as part of a general infection the symptoms of the latter cover those of the former.

Acutest Septicemia.—This form, the most dangerous of all forms of puerperal infection, has, fortunately, become very rare, and has entirely disappeared from well-conducted lying-in hospitals, institutions where it formerly raged in the so-called "epidemics" of *puerperal fever*.

It begins soon after delivery with a long and severe chill. The pulse and the respiration are rapid. The temperature in some cases may be high, and may remain so without the remissions characteristic of puerperal phlebitis, but in other cases it is normal or even subnormal. The features are pinched, the skin pale or purplish, and the tongue dry and brown. The patient is in a somnolent, comatose, or delirious condition. She has frequent involuntary, copious, dark, and offensive evacuations from the bowels. The urine is scant, and it contains much albumin. The course of this form is rapid and ends in death in a day or two.

Gonorrheic Infection.—Gonorrheic infection is really a kind of puerperal infection, since it, like the infection due to streptococci, staphylococci, and other microbes, may lead to both local and general infection, peritonitis, arthritis, endocarditis, and death. Still, it may be an advantage to treat it separately, because this infection is due to a particular microbe,—the gonococcus of Neisser,—because it is a common cause of auto-infection, and because, as a rule, the prognosis is better than when the infection is produced by streptococci and staphylococci.

The patient may have had a gonorrhea a long time before delivery. There may only be left a small number of gonococci in her vagina, but a few days after delivery it will be full of them. It seems that the lochial discharge furnishes a particularly favorable soil for their growth, and from the vagina they may wend their way into the uterus.

In the beginning there may not be any symptoms, or only slight ones, such as a little tenderness on pressure on the uterus and a little fever, but two or three weeks later pyosalpinx, an ovarian abscess, and pelvic peritonitis may develop. In exceptional cases this may even happen early in the puerperium.

The *diagnosis* is based on the presence of the gonococcus, venereal warts in the mother, and ophthalmoblennorrhea of the child.

Sometimes the gonococcus is the only infecting agent, but in other cases it may be combined with streptococci and staphylococci.

The treatment should chiefly be directed against the vagina, where lysol

douches (not corrosive sublimate) are useful. Intra-uterine injections and curettage are contraindicated. The inflammation is combated with the application of ice-bags and the administration of opiates.

Treatment of Puerperal Infection.—Puerperal infection being a bacterial disease, its treatment, preventive as well as curative, must chiefly be germicidal. Asepsis and antisepsis are the watchwords in the warfare against it.

It is an interesting historical fact that the great discoveries which form the base of all antiseptic surgery were made by obstetricians long before they were independently made by surgeons, but that the obstetrical discoverers did not succeed in changing the treatment of puerperal disease by other practitioners until the surgeons stirred up the entire world by their wonderful achievements by means of antiseptic measures.

The father of antiseptic midwifery was Semmelweis of Vienna, who as early as 1847 understood that so-called "puerperal fever" was due to infection, and who used chlorin, one of the best germicides, in the shape of chlorinated lime as a disinfectant. But his great discovery remained an uncut diamond, lying despised in a corner, for a whole generation, the discoverer meanwhile dying in a mad-house. It was when the Scotchman Lister, applying the discoveries of the French chemist, Pasteur, to surgery, had laid the foundation of antiseptic surgery (1866), that the Danish obstetrician, Stadfeldt, and the Swiss obstetrician, Bischoff, simultaneously (1870) introduced the use of carbolic acid in midwifery.[37]

In 1881 the French obstetrician, Tarnier, read a paper before the International Medical Congress assembled in London on his use of bichlorid of mercury as a local remedy for puerperal fever, but no one seems to have paid any attention to it until the German bacteriologist, Robert Koch, published his experiments with this drug, and the German surgeon, Schede, introduced its use in surgery. The bichlorid of mercury, as a preventive and curative agent, was then (in 1883) introduced in many lying-in hospitals. In America it was first introduced in the New York Maternity Hospital by the writer on the 1st day of October, 1883.

While the revolution in the results as to morbidity and mortality from puerperal infection dates from the introduction of bichlorid of mercury, it has, however, been proved that the true cause of the improved results is not to be sought in the drug, but in its application; that is, the *strict* disinfection of hands, instruments, dressing-material, etc. Some large clinics, such as those of Copenhagen and Vienna, yet cling to the use of carbolic acid,[38] and obtain just as good results as those in which this drug has been supplanted by bichlorid of mercury.

If ever a medical fact has been proved by figures, the latter have proved the value of the antiseptic treatment in midwifery. The testimony from over the entire world, independently of geographical position or climatic differences, is unanimous. Counting by thousands, hundreds of thousands, and millions, the figures are too large to be vitiated, the new treatment being now in the nineteenth year of its probation.

It would be tiresome and unprofitable to enter deeply into statistics, but the writer can hardly begin the discussion of the treatment of puerperal infectious diseases in a better way than by showing, in a few lines, what the mortality formerly was and what it became in the institution to which he had the honor of being a visiting obstetric surgeon for a period of over ten years (1881–92), and with which he is yet connected as consulting obstetric surgeon.

The records of the New York Maternity Hospital show the following mortality before and after the introduction of strict antiseptic treatment with bichlorid of mercury:

Year.	Deliveries.	Deaths.	Per cent.
1875	570	15	2.63
1876	536	20	3.73
1877	480	32	6.67
1878	255	7	2.75
1879	254	11	4.33
1880	149	8	5.37
1881	382	9	2.36
1882	431	14	3.25
1883	447	30*	6.71
Total	3504	146	4.17

* All during the first nine months of the year.

During the last six months before the change in treatment was made there were delivered 237 women, nineteen of whom, or 8 per cent., died, and of these seventeen, or 7.17 per cent., succumbed to sepsis. During the last month the total mortality reached even ten out of fifty, or 20 per cent., and that from sepsis 15.69 per cent.

During the first three months after changing the treatment there were 102 deliveries, without a single death—a circumstance which then appeared almost miraculous, but which has become quite a common event, and has later been extended over much longer periods. The following list shows the mortality in the New York Maternity Hospital after the introduction of strict antisepsis:

Year.	Deliveries.	Mortality.		Per cent.	
		Total.	From Sepsis.	Total Mortality.	From Sepsis
1884	522	8	4	1.53	0.76
1885	537	3	0	0.56	0.0
1886	446	5	1	1.12	0.22
1887	389	5	1	1.30	0.26
1888	377	3	0	0.79	0.0
1889	314	1	0	0.32	0.0
1890	345	4	1	1.13	0.29
1891	240	1	0	0.42	0.0
1892	314	1	0	0.32	0.0
1893	305	2	0	0.66	0.0
Total	3789	33	7	0.87	0.18

Thus, *during the last three years on the list, out of 1059 parturient women only 4 died, or 0.37 per cent., and not one of them from infection.*

By comparing the preceding lists, comprising respectively nine and ten years, we find a decrease in mortality from 4.17 to 0.87 per cent.; that is, the mortality has been reduced nearly to one-fifth of what it formerly was.

In regard to morbidity a similar change has taken place, but the writer has no exact statistical material to offer as proof. He must, therefore, confine himself to an example. During the six months from October 1, 1882, to April 1, 1883, a period for which he has exact notes respecting the whole service, 192 women were delivered, 46 of whom, or *nearly 1 out of 4, were seriously ill*, and 39, or nearly 1 in 5, suffered from puerperal inflammation, which now-a-days is looked upon as due to infection. After the change in treatment a sick puerpera became a rare sight in the wards of the Maternity Hospital.

I have no means of following the example of German obstetricians in giving the percentage of what they call morbidity—that is, any rise in temperature above 100.4° F. When funds went low in the Commissioners' cash-box I had sometimes considerable trouble in obtaining any clinical thermometers. The instruments furnished were of the cheapest. Observations were made by pupil nurses. While the charts made from them were of practical value to the Visiting Obstetrician, they would be utterly valueless if used to compare our institution with others, as they do in Germany.

It is also too much against the practical turn of mind of the American physician to waste time in searching for the cause of these slight disturbances in normal conditions, which would never be known if we did not use thermometers, since the patients feel well and get well in the same period, as if there were no rise in temperature.

The investigations of Burchardt,* alluded to above, make it highly plausible that these mild or symptomless fever cases are due to secondary infection of the genital tract from the skin during the puerperium.

A certain class of cases is particularly interesting, because all the symptoms of cellulitis—namely, pain, tenderness, and swelling in one of the iliac fossæ—were present, and still there was no rise in temperature—a phenomenon which can be accounted for only in this way: that the condition was due to bruising of the tissues, and that our antiseptic treatment prevented the infection which so easily develops under such circumstances.

Passing to an exposition of the treatment of puerperal infection, we must distinguish between hospital practice and private practice, preventive and curative treatment, which, again, may be medical or surgical.

I. Prevention of Puerperal Infection in Hospitals.—Parturient women ought to be provided for in institutions exclusively designed for obstetric purposes, and not in general hospitals. Before the introduction of antisepsis the mortality was much greater in the wards of general hospitals devoted to obstetric cases than in special lying-in asylums; and even after the introduc-

* Burchardt, *Centralbl. f. Gynäk.*, 1899, p. 1274.

tion of antiseptic prophylaxis it exposes parturient women to increased risks to be treated by the same doctors and nurses who have charge of the sick.

A lying-in hospital ought to have a free supply of pure air, which ought to circulate freely under the building, whether there be a cellar or the building be erected on pillars. If possible, there ought to be in the wards artificial ventilation, which can be obtained in the highest degree of perfection only by large fans revolving under the building and throwing pure air into the wards. During the cold season the air is heated before being forced into the wards by the fans.

Where there is no artificial ventilation the windows must be kept more or less open at the top day and night the year round. Although this procedure interferes somewhat with the normal perspiration in childbed, the writer has never observed any harm arise from it in the Maternity Hospital: this immunity probably is due to the habitual exposure of the special class of women there confined, for in private practice the writer has seen coryza, bronchitis, and pneumonia originate from a similar procedure.

The building should preferably be so situated that the patients may get the morning and evening sun; at all events, a northern exposure should be avoided in the temperate zone, and a southern exposure in very hot climates. Even the smallest lying-in hospital should have one or more special rooms for isolating sick patients from the other puerperæ.

There ought to be a regular and rapid rotation in the use of wards. In the Maternity there are nine beds in each ward, and as soon as the last patient has been there nine days the ward is temporarily abandoned and disinfected, the same bed never being used by more than one and the same patient before being thoroughly disinfected. On the ninth day the patient is transferred to the convalescent ward, where she stays until she is well enough to leave the hospital.

Pregnant women ought to be kept in special waiting wards apart from parturient and puerperal patients. While waiting, the pregnant women often stay for months in the Maternity Hospital, and it is more difficult to keep discipline among them. They need other food and regimen; they are less clean and less quiet; they would be exposed to unnecessary anxiety by witnessing the sufferings of the parturient or sick puerperal women; and they might, perhaps, even become infected before their delivery.

The parturient woman ought to be delivered in a special delivery-room, a so-called "pony-room."* As the infection most frequently takes place during parturition, the woman should be delivered in a room where everything is kept strictly aseptic, and by all means not in a room where there are sick puerperæ.

There should be an easy communication between the delivery-room and the wards, so that patients need not be carried far or be exposed to inclement

* The writer believes this singular expression comes from a small bed, a kind of cot, which was called a "pony," and which was used for deliveries in olden times, as it yet is in some countries —for example, Belgium.

weather; yet there should be no direct communication. In the Maternity Hospital this condition is obtained by having small covered corridors, open on one side, between the delivery-room and the wards.

The wards should likewise be separated from one another. They should have plenty of light, preferably from two opposite sides. Light from above is only needed in an operating-room. All cross-beams and projections should be avoided, as they become receptacles for dust, which may become a carrier of germs. The floor and walls should be hard, smooth, and not porous, so that they can easily be kept clean by scrubbing and be disinfected with fluids or with vapors. It is well to have separate rooms provided for patients who have undergone serious operations.

The question of heating is important. It is best to have a combination of different systems. Warm air may be thrown into the wards by fans; steam may circulate in pipes: both these methods ensure a steady supply of heat, and prevent the water from freezing in the supply-pipes in cold weather. Open fires are cheerful; they give a very pleasant radiating heat, contribute to ventilation, and offer an easy way of disposing of small unclean substances, which otherwise may accumulate and vitiate the air in the ward. Stoves combine to some extent the qualities of a radiator and an open fire, and they are more economical. By the evaporation of water the air should be prevented from becoming too dry.

The isolating department should be separated entirely from the common wards, and each patient should occupy a room by herself. This department should have a special doctor and special nurses, who are not allowed to enter the wards. The physician-in-chief alone should see the whole service.

Water-closets should be of the very best kind, and never be situated in the wards or in the rooms. They should not even communicate directly with the wards or the rooms, but should be separated from them by vestibules with two doors. In the space between the doors a window should constantly be open, and the doors should close automatically.

There should be a place where all linen and bed-clothes used by sick puerperæ can be disinfected by immersion for an hour in bichlorid solution (1 : 1000) before they are washed; if mattresses are used, there should be a room where they, as well as the blankets, can be fumigated with formalin or be disinfected by exposure to superheated steam.

No visitors should be admitted to the wards, as they often come from crowded tenement-houses in which there may be cases of measles, scarlet fever, small-pox, or diphtheria.

The members of the house-staff should not be allowed to enter the wards occupied by other patients, the isolating-rooms, the dead-house, and still less be permitted to make autopsies or to handle anatomical or pathological specimens.

Disinfection.—The principle upon which disinfection is based is the belief that puerperal infection is due to bacteria found on the patient, on doctors and nurses, on all surrounding objects, on everything brought in con-

tact with the genitals, and in the air of the room. We shall, therefore, have to consider the disinfection of the ward with its furniture, of the patient and of those who minister to her, of all instruments and materials that come in contact with her, and of the air that reaches her genitals.

Ward Disinfection.—When the last patient has been nine days in a ward it is not used again until thoroughly disinfected. The bed-clothes are taken off the beds, the linens are sent to the laundry, and the blankets are spread over the ends of the bedsteads. All windows, doors, and registers are closed, key-holes stuffed with paper or rags, and loosely fitting doors made tight with cotton or oakum and strips of thick paper smeared with paste. By means of a special apparatus—Schering's disinfector—formalin pastils are made to evaporate in the room. For each cubic meter, or 35 cubic feet, 2 pastils should be used. After from twelve to twenty-four hours all doors and windows are opened, and, if the ward is not needed immediately, they are left open for several days. The walls, the floors, and the furniture are scrubbed with soap and water, and thereafter with a solution of bichlorid of mercury (1 : 1000). So long as straw mattresses were used in maternity hospitals the straw was burned; the patients now lie on woolen blankets spread over a woven-wire mattress.

All bed-clothes used by sick puerperæ are first immersed for an hour in the solution of bichlorid of mercury, and are then preliminarily washed before sending them to the hospital laundry, where they are mixed with the other bed-linen. Patients and nurses wear only such clothes as can be washed. The clothing of the doctors, when required to be disinfected, is suspended in a small room and fumigated with formalin.

Disinfecting the Patient.—When a patient is taken in labor she is given a full bath of tepid water, thoroughly scrubbed with soap, and dressed in clean clothes. She is next placed on the delivery-bed on a rubber blanket that has been disinfected with bichlorid (1 : 1000), or sterilized by heat, and the lower half of her body is washed with bichlorid of mercury (1 : 2000), taking particular care to clean every furrow at and near the genitals and the umbilicus. The writer has given up the preliminary vaginal douche, except in cases in which there is a purulent discharge. Then creolin or lysol is used (two quarts or more of a 1 per cent. emulsion).

Disinfection of the Doctors and Nurses.—The accoucheur takes off his coat, vest, necktie, collar, and cuffs, rolls up the sleeves of his shirt and underwear to the middle of the arm above the elbow, and covers himself with a large rubber apron reaching from the shoulders to a little above the ankles. He next anoints his hands and arms with soft potassa soap, and scrubs them thoroughly with warm water and a stiff nail-brush, taking particular care to clean the spaces under the nails and at their roots. He then scrapes his finger-nails with a steel nail-scraper; and, finally, he scrubs all these parts while holding them for at least three minutes in a solution of bichlorid of mercury (1 : 2000). Some use only soap, very hot water, and alcohol for disinfecting the hands, and obtain as good results, but while corrosive sublimate

is one of the cheapest, alcohol is one of the most expensive disinfectants. The accoucheur is now ready for work, and must not wipe his hands or arms. But, as it is next to impossible to avoid touching different objects from which new disease-germs may be transferred to the hands of the physician, a basin with a warm solution of lysol (1 per cent.) is kept at the bedside, and with this solution he rinses his hands at the moment before touching the patient. The nurses disinfect themselves with the same care and in the same manner as the doctor.

If the accoucheur has had a patient affected with puerperal infection, erysipelas, scarlet fever, suppuration, or other disease likely to cause puerperal infection, he must take special precautions. If possible, he should stay a quarter of an hour in a full warm bath containing two drachms of bichlorid of mercury, washing the hair and beard carefully while in the water. At all events, he should scrub his hands with greater care than under ordinary circumstances, and should immerse them a longer time, say five minutes, in a stronger solution (1 : 1000).

The use of bichlorid for disinfecting the hands may advantageously be followed by other disinfectants, such as chlorin, lysol, and alcohol. Chlorin is developed by taking a teaspoonful of chlorinated lime and as much carbonate of potassium in the hollow of the hand, and form a paste of it with a little water, which paste is rubbed all over the hands. After rinsing them they are immersed in lysol (1 per cent.), and finally held in a bowl with alcohol or rubbed with pledgets of absorbent cotton soaked in this drug.

Disinfecting the Materials.—All materials coming in contact with the genitals, such as absorbent cotton, lint, etc., are sterilized with overheated steam.

Disinfecting the Instruments.—All instruments are disinfected by boiling them at least five minutes in a solution of washing-soda (a tablespoonful to each quart of water), and they are cleaned very carefully after having been used. All instruments composed of several parts are taken apart. No sponges are used. They have been replaced by sterilized absorbent cotton, lint, or gauze.

Sutures and ligatures are of course carefully sterilized. Silkworm gut stands boiling in water and is kept in alcohol. Catgut may be made sterile by boiling it in alcohol in a closed vessel * or treating it with formalin, cumol, or dry heat.† Silk is boiled for half an hour in water, immersed for half an hour in bichlorid (1 : 1000), and is kept in alcohol. If a sterilizer is available, it suffices to expose the silk to the effect of circulating steam for an hour.

Antiseptic Conduct of Labor.—Very few *vaginal examinations* are made, and the person making them disinfects his hands immediately before the procedure. With the left hand he spreads the labia wide open before introducing his right index-finger, so as to avoid carrying microbes from the vulva into

* This method of George R. Fowler has been made easy and economical by the introduction of Charles N. Dowd's condenser.

† See Garrigues' *Text-book of Diseases of Women*, third edition, pp. 213–215.

the deeper parts. In ordinary cases the examining finger should not be brought beyond the external os. We know that pathogenic microbes may be found in the vagina, and even in the cervix, and they are by no means sure to be removed by a preliminary douche. If, therefore, the finger is brought from the vagina into the cervix, or, still worse, into the uterine cavity, it may carry disease-germs into the uterus.

During the delivery the accoucheur should wear a sterilized gown and cap, as in a surgical operation.

No *lubricants* are used. The lysol adhering to the finger or the forceps is all that is needed. The only exception made by the writer is when, in the operation of version, the whole hand is introduced into the womb, in which case the dorsal surface of the hand is smeared with mollin containing 5 per cent. of carbolic acid. Lubrichondrin in tubes is also good. In protracted cases the vaginal douche is repeated every three hours.

When the head begins to open the vulva the latter is covered with a piece of sterilized lint. This is done partly to prevent the entrance of microbes from the air in the room, and partly because, by obviating slipperiness, it facilitates all manipulations calculated to protect the perineum.

The placenta is removed by *Credé's expression method* (Fig. 257, Vol. I.); that is, in ordinary cases not even a finger is introduced into the genital canal after the birth of the child, the placenta being squeezed out by compressing the uterus through the abdominal wall. The writer does not, however, remove the placenta so soon as recommended by Credé, rarely removing it earlier than fifteen minutes after the birth. The membranes should be removed very slowly and cautiously, as they adhere to the inner surface of the uterus; otherwise they would be torn off and remain in the uterus, where they may give rise to puerperal infection.

If on inspection any part of the placenta is missing, the well-disinfected hand of the physician should be introduced into the uterine cavity and the missing part scraped off with the nails. As a rule, the writer does the same for larger portions of membranes. If, however, the rope formed by the membranes breaks and the uterine end is within reach, the writer sometimes ties a silk thread to it, since the retained piece, as a rule, can easily be removed the following day by pulling on this ligature.

Intra-uterine injections are used if the fingers, the hands, or the instruments have been introduced into the uterus. The fluid injected is a 1 per cent. emulsion of creolin or lysol at a temperature of from 110° to 115° F. The apparatus used for the injection consists of a douche-can (Fig. 133,[1]), and a glass tube (Fig. 133,[2]), having a hole at the end and several on the sides near the end. Before introducing the tube into the uterus the vagina is irrigated. Great care should be taken in introducing the tube. The distance from the fundus uteri to the rima pudendi should be measured by holding the tube over the abdomen and noting how far the tube is to be inserted. The left index and middle fingers are introduced into the cervical canal and the tube is inserted between them. It should be ascertained if the tube goes in the

direction of and reaches the fundus; this can be done by feeling the resistance offered by the latter, or frequently by feeling the end of the tube through the abdominal wall. If any difficulty is met with, the tube should be withdrawn a little and reintroduced in another direction. The douche-can should be held not higher than a foot above the uterus. At the end of the injection the fluid remaining in the uterus should be pressed out.

Dressing.—After the removal of the placenta the patient is again washed with bichlorid and the coagula removed from the pubic hairs, or, if the latter are long and matted together, they should be cut off, which preferably may be done before disinfecting the genitals before labor. It was the routine practice in the Maternity Hospital to hold the uterus compressed for half an hour after delivery. At the end of this time an occlusion bandage (Fig.

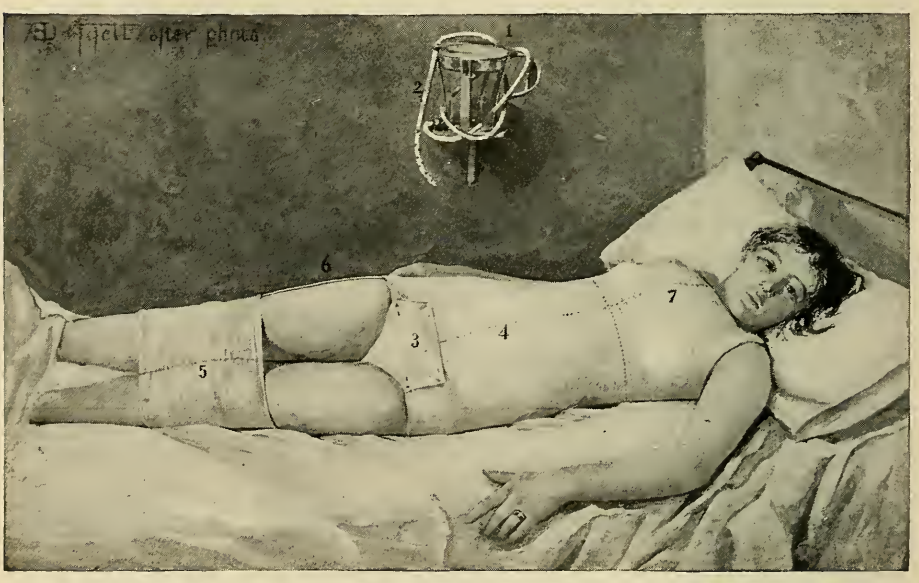


FIG. 133.—Garrigue's bandages, douche-can, and intra-uterine tube: 1, douche-can; 2, intra-uterine tube; 3, perineal pad; 4, abdominal binder; 5, knee-binder; 6, suspenders preventing knee-binder from sliding down; 7, breast-binder (from a photograph).

133,[3]) was laid over the genitals and fastened to the binder (Fig. 133,[4]). This bandage consists of a piece of absorbent lint (12 by 8 inches, folded twice, so as to be 3 inches wide) reaching from the genito-femoral furrow on one side to that on the other side, and covering the vulva and the anus. This pad was first wrung out of the creolin emulsion, and after being applied was covered with a piece of oiled muslin measuring an inch more than the pad in both directions. This oiled muslin was washed with creolin and was turned forward on the inner side of the thighs. Outside of the muslin was placed a somewhat larger pad of dry cotton batting, which was held in place by a piece of unbleached muslin half a yard square and folded like a cravat (5 inches wide), which in front closed a ∧-shaped opening left at the lower end of the binder, and which was fastened to the binder with four pins.

Behind only two pins are needed. Since the introduction of aseptic methods the perineal pad consists simply of a pad of sterile gauze without water-proof material, but retained in the same way. But in private practice the writer uses the antiseptic pad described here. The dressing is changed every six hours and every time the patient urinates or has a movement of the bowels. On making the change a bed-pan is pushed in under the patient, and the outer surface of the genitals is irrigated with creolin or lysol. No vaginal injection is used. The genitals are not even touched.

Ergot.—Contraction and involution being great preventatives of puerperal infection, a drachm of fluid extract of ergot is given three times a day until an ounce has been used.

Perineorrhaphy.—All lacerations of the perineum are repaired immediately, the best material for suture being silkworm gut.

Catheterization.—When the patient is unable to urinate, the vestibule is washed with lysol emulsion and a well-disinfected catheter is introduced. The common flexible catheters, made of some woven fabric covered with varnish, are strictly prohibited, as they cannot be kept clean. The best catheters are of metal or of glass, which can be boiled and be kept aseptic in a solution of carbolic acid (5 per cent.). If, exceptionally, a flexible catheter is needed, it should be of soft rubber, which is disinfected by boiling it in soda solution.

Syringes.—If injections are used, great care should be taken to disinfect the nozzle of the syringe by boiling it. Nozzles employed in a serious case should preferably be destroyed, as only glass nozzles are used, and they are quite inexpensive.

Much has been written during the last ten years respecting prevention of puerperal infection, and opinions concerning it differ greatly among leading obstetricians; for instance, regarding the use of ergot, which some extol and others look upon as a direct promoter of infection; vaginal injections, which in the eyes of some are superfluous or harmful; and vaginal examinations, which some fanatics would abolish altogether. The only changes made by the writer are to substitute creolin or lysol (1 per cent.) for corrosive sublimate for vaginal and intra-uterine douches, on account of its greater safety,[39] and to rely so far as possible on aseptic instead of antiseptic methods.

II. Prevention of Puerperal Infection in Private Practice.—The benefit of the antiseptic treatment in hospitals has been so enormous that all criticism has been silenced and every doubt has vanished. From one end of the civilized world to the other the treatment is essentially the same. But how different is it when we come to private practice! So recently as 1875 the International Congress of Physicians and Surgeons assembled at Brussels, Belgium, adopted resolutions to the effect that, on account of the great mortality in lying-in asylums, all such institutions should be abolished. Since that time the tide has turned. The hospital is now the safe place for a woman to be delivered in; it is in private dwellings that lurks the danger. The poorest, the dirtiest, and the most dissolute women are safely confined in a lying-in

institution; the richest, the youngest, the purest, and the loveliest sometimes succumb in giving birth to a child in their own homes. In the private obstetric practice of the writer there is neither death nor sickness referable to infection, while in consultation practice he frequently sees death follow childbirth or abortion. What is the cause of the difference? It is only that the writer uses strict antisepsis, and that most general practitioners do not. Some smile benignly at the mere thought of using such superfluous measures in private practice; others have a little mercuric chlorid or carbolic acid around the house, but use it without system or perseverance. Still, there is much greater danger of the patient being infected by the doctor or the nurse in private practice than in a well-appointed lying-in asylum. The young men composing the house-staff of a lying-in asylum are strictly forbidden to enter the wards of a hospital; they have no private practice; they do not see an autopsy; and if, unfortunately, the service is a department of a general hospital, the clothes and the bodies of the nurses before going from one department to another are subjected to thorough disinfection under the supervision of their superiors. In private practice, on the contrary, the physician may have treated a case of diphtheria or of erysipelas a moment before being called to a confinement; and nearly all private nurses take promiscuously medical, surgical, and obstetrical cases, disinfecting themselves as best they know how or according to the promptings of innate laziness combating acquired conscientiousness.

As a matter of fact, the mortality in private practice is twice as large as that in hospital practice, or larger. *Out of every hundred, ninety-five, or even eighty-nine women delivered in New York or other large cities in private practice, one dies;* that is, up to 1.12 per cent. against 0.6, 0.5, or even 0.4 per cent. in the best lying-in establishments.

Country practitioners are still greater opponents of antiseptic midwifery than their professional brethren in the cities, the country practitioner relying on the purity of the atmosphere in which he works and on the robust constitutions of his patients. If, however, these conditions may help the women to get well, they cannot to any great extent prevent them from being taken ill. In many respects country practice exposes the patient even more to infection than does city life. In most places there is no drainage. Manure is spread over the fields or the garden close to the house in which live the farmer and his wife. The village butcher kills his cattle, lets the blood soak into the ground, and nails the skins to the barn-doors, whence their odor can be smelt far away. The country practitioner cannot go home and change clothes and bathe: he must make his round or he would never get through with his work; and thus it happens that the same hand that was thrust into a perineal abscess, that performed tracheotomy on a child suffering from diphtheria, or that dressed a patient attacked by bullous erysipelas, at the next house is brought up to the fundus of the uterus in order to take away an adherent placenta.

The statistical researches of Ehlers show a large preponderance of puerperal mortality in the country compared with the cities in Prussia. In some provinces the mortality in child-bed of women between twenty-five

and forty years of age reached 20 per cent. of the total mortality for the same age.

The same antiseptic precautions that have revolutionized lying-in asylums should be used as well in private practice, be it in the city or in the country. On October 27, 1892, the Obstetric Section of the New York Academy of Medicine, on a motion by the writer, unanimously passed the following resolution:

"*Whereas*, Experience both in this country and abroad shows that by strict antiseptic measures the total mortality in lying-in hospitals may be reduced to a few per thousand;

"*Whereas*, Deaths due to childbirth or to abortion are yet common in private practice;

"*Resolved*, That in the opinion of the Obstetric Section of the New York Academy of Medicine it is the duty of every physician practising midwifery to surround such cases in private practice with the same safeguards that are being used in hospitals."

Since this resolution was formulated considerable changes have been made in hospital practice, the rules of aseptic surgery having replaced those of antiseptic surgery. In hospitals this is entirely proper. No such institution should be without sterilizers, and all materials and instruments coming in contact with the genitals should be made aseptic by overheated steam, dry air of a high temperature, or boiling in a solution of soda. But in private practice the writer thinks we should chiefly be satisfied with antiseptic obstetrics, and not aim at an asepsis which gives endless trouble, which entails considerable expense, which most of the time will be found impossible, and which is not necessary for perfectly satisfactory results. There is, of course, no objection to the boiling of instruments, but to have sterilized towels, sheets, and aprons is not feasible in the large majority of private houses. In private practice the writer relies entirely on lysol and alcohol, besides hot water, soap, and a hand-brush, for disinfecting the patient, the nurse, himself, and the perineal pad. The forceps and other instruments he boils with soda (a tablespoonful for each quart of water) for five minutes, and lubricates them by immersion in lysol (1 per cent.).

If we ask too much, we shall meet with strenuous opposition both from the general practitioners, who have to make a living, and from the patients who, with few exceptions, are neither able nor willing to spend more than a very limited sum on a confinement.

By scrubbing the hands for three minutes with soap and as hot water as he can stand, scraping his nails carefully, and then washing his hands for another three minutes with lysol, and finish off with pledgets of absorbent cotton soaked in alcohol, a physician may obtain such a degree of cleanness as reasonably can be demanded. Besides, he should all the time have a basin with lysol emulsion (1 per cent.) within easy reach, and again and again dip his hand and all material that comes in contact with the patient's genitals in the fluid immediately before contact is made.

For suture material the writer relies on that prepared by George St. John Leavens, 72 Bible House, New York, which is easily carried in the satchel.

In practice in well-to-do families we should choose a large, airy, sunny room, situated as far as possible from the water-closet. Should, however, the lying-in room be close to the water-closet with a door leading directly from the one to the other, this door should be locked, and some of Platt's chlorid or other powerful disinfectant should be poured frequently into the basin.

Instead of lint, the writer uses for the pad in private practice absorbent cotton, and instead of oiled muslin he uses gutta-percha tissue. The pad is not changed in the middle of the night. The patient is directed to have three basins, three pitchers, and a fountain syringe, which articles are personally cleansed by the writer before bringing them into use. A gallon of cold sterile water should also be on hand.

In the dwellings of the poor the antiseptic precautions may be much simplified and yet be quite effective. The perineal pad may be made of common cotton batting, and the gutta-percha tissue may be dispensed with. A tin basin may be used instead of a bed-pan. The doctor can easily carry in his satchel some tablets of corrosive sublimate and a couple of ounces of creolin or lysol, and thus be prepared to disinfect himself and his patient at slight expense to himself and none to his patient. Intra-uterine douches can be made with a soft-metal catheter costing fifty cents.

No one can foresee—the average general practitioner least of all—what complications may arise during labor. Where an easy delivery has been promised the healthy primipara, it may become necessary to perform version, symphysiotomy, or craniotomy, the result of either of which operations depends almost entirely on the aseptic or septic condition of the patient at the time of its performance, taking for granted that the operator uses all antiseptic precautions. *The doctor and the nurse should know that they jeopardize their patient's life by introducing into her vagina a finger that is not disinfected.* During labor dangerous microbes will not be destroyed by phagocytes or by the chemical composition of the secretions, as we are told they are under other circumstances.

III. Curative Treatment of Puerperal Infection.—The curative is much less effective than the preventive treatment. Since infection, in the vast majority of cases, takes place in the genital canal, the first procedure indicated is the removal of the microbes that have not yet entered the tissues, which removal is effected by ablution and injection with antiseptic fluids. The second procedure is to seal the entrances, which is done by means of cauterization. A third procedure is to clean the intestinal canal by an aperient or by enemas. A fourth procedure is to sustain the strength of the patient in order to give her a chance to throw off the poison that already has entered her tissues or that circulates in her blood. Stimulants are therefore used freely; as much food is given as it is possible for the patient to digest; and tonic drugs are administered. A fifth procedure is to combat pain, which indication is met by narcotics and ice. The sixth procedure is to reduce the patient's

temperature if it becomes dangerously high, which is done by ice-bags, by an ice-water coil, by refreshing ablutions, or by cooling baths.

In describing the details of the treatment followed in combating puerperal infection the same anatomical categories will be used as on the preceding pages, but the reader must bear in mind that what is described under different headings is really one and the same disease, modified only by the intensity of the affection or by the nature of the tissue affected. To avoid endless repetitions, a mode of treatment will, as a rule, only be mentioned under that organ in the affections of which it is chiefly employed, but with the understanding that a similar condition in another organ calls for similar measures. Thus the means of reducing the temperature are discussed under *Peritonitis*, but what is said there applies as well to cases in which there is a high temperature without inflammation of the peritoneum.

Sometimes the lochial discharge becomes fetid, there is a moderate rise in the temperature not exceeding 102°, some acceleration of the pulse, but no tenderness, no swelling, and no ulceration. This condition is probably due to a *very mild degree of infection with saprophytes.* Often a blood-clot hidden in the deep pouch at the posterior fornix or in the interior of the uterus is the cause of such a condition. Health is, as a rule, soon restored by using disinfectant vaginal injections of creolin or of lysol every three hours, by moving the bowels, and by administering 5 grains of quinin three or four times a day.

Aidoitis and Colpitis.—The catarrhal inflammation of the external genitals calls only for the above-mentioned vaginal douches three times a day. Simple ulcers may besides advantageously be dusted with iodoform, with dermatol, or with stearate of zinc, or be covered with iodoform ointment:

℞. Iodoformi, ʒj;
Balsami peruviani, ʒij;
Vaselini, q. s. ad ℥ij.—M.

If the sores become diphtheritic, it is the practice of the writer to touch them with a solution of chlorid of zinc:

℞. Zinci chloridi,
Aquæ destillatæ, *āā* ʒj,

which is applied by means of a stick wound with absorbent cotton. The caustic should be applied very thoroughly, and be held in contact for a minute. The vagina is then syringed with creolin or lysol.

If the perineum has been stitched, the sutures should be removed, as the torn surface is already or will be infected, and it must be treated in the above-mentioned way. Tears in the deeper part of the vagina are exposed by means of a speculum. The application of zinc being very painful, the parts should be made insensible with a 10 per cent. solution of cocain, or general anesthesia must be produced. The vaginal injections are repeated every three hours.

Once in twenty-four hours the parts are inspected, and if new patches have formed the same procedure is repeated.

The application of chlorid of zinc brings out the diphtheritic infiltration much more distinctly, the affected part becoming milk-white. Later, there is formed a grayish slough which is very much like a diphtheritic patch. To distinguish old sloughs from new patches the physician must remember where he has cauterized the preceding day, and pay attention to the contour of the affected place. A slough produced by cauterization has a plain curved outline, while that of a new diphtheritic patch has a scalloped contour, the infiltration spreading more rapidly at one point than at another.

The object to be attained by cauterization is both to kill the microbes found in and near the wound, and to seal lymphatics and veins leading from the ulcer to the deeper parts. The writer has found chlorid of zinc much more effective for this purpose than tincture of iodin, iodoform, liquor ferri subsulphatis, or liquor ferri chloridi.

The general treatment consists in giving an aperient if the bowels have not moved freely, 5 grains of quinin every four hours, half an ounce of brandy or of whiskey with equal parts of milk or water every two hours. For a change egg-nog may be substituted two or three times a day. If strong liquor is not well borne, it may be replaced by a corresponding amount of port, sherry, tokay, or angelica wine, but, as a rule, alcohol can be taken in large amounts without producing intoxication.

If there is a patient suffering from diphtheria in the house; or, still more so, if culture experiments show the presence of the Klebs-Löffler bacillus diphtheriæ in the wound, Behring's diphtheria antitoxin should be injected.

If there is *gangrene* of the vulva or of the vagina, the stimulant treatment should be pushed still more, the dead tissue should be removed with knife and scissors as soon as feasible after the formation of a line of demarcation, and healing be promoted with iodoform or with camphor emulsion (see under *Bed-sores*).

Endometritis and Metritis.—If the large size of the uterus, its tenderness, and the discharge of a dirty and offensive fluid show that the uterus itself is the seat of inflammation, the question to be decided is whether it is empty or whether it contains parts of the secundines. If there is the slightest doubt in this respect, the first thing to be done is to anesthetize the patient, place her on a table, in the dorsal posture with elevated bent knees. The physician then lubricates his hand and introduces it into the vagina, thrusting one or two fingers into the interior of the womb. If necessary, the whole hand may be introduced. In either case the operator should examine systematically the whole endometrium, and especially be sure to reach both ostia uterina of the Fallopian tubes, where often a piece of placenta is retained. The finger-nails are used as scrapers. The other hand is laid flat on the fundus, steadies the uterus, and brings the fundus within easier reach. If possible, it is of great advantage to enter the finger at one edge of the part to be removed and to

take it away in one piece. Often, however, we must remove it piecemeal. It is not necessary to withdraw the hand. By pressing the loosened part between the fingers and the palm of the hand the tissue to be removed is made to follow the inner surface of the arm down to the os, from which it is finally removed in withdrawing the hand.

If the uterus has contracted too much to allow the hand to be introduced, and the obstetrician cannot reach the fundus with the fingers, even by pressing well on it from the outside, he may employ instead a large dull wire curette. This instrument is 14 inches long, has a shank a quarter of an inch thick, and an eye large enough to admit the tip of the thumb. In using the curette the writer as a rule prefers to place the patient in the Sims position. He has used the wire curette as early as the end of the second month of pregnancy in abortion cases, after having dilated the cervix with Hanks's and his own dilators. At a still earlier period the writer uses the Simon sharp spoon. Whenever it is possible the left forefinger should be introduced beside the large curette, so as to be able to feel the part to be removed and to seize it between the finger-tip and the eye of the curette, which is safer than any kind of placental forceps.

Many obstetricians are opposed to the use of the curette in obstetric cases, maintaining as an argument that new wounds are produced by it, and that blood accumulates and forms a fertile soil for bacteria.[40] In the writer's experience the curette is of great value—even indispensable—in abortion cases, but after confinement he always uses the hand if possible. If the instrument is used after the poison is no longer localized and the patient is profoundly septic, the curette can accomplish very little good, and may, on the contrary, do the greatest possible evil by breaking down the beneficent inflammatory layer which nature puts up as a wall between the microbes and the deep, still unaffected tissue.

When the internal surface is smooth, the uterus is washed out with two or three quarts of creolin or lysol (1 per cent.), the patient being in the dorsal decubitus. If there is much bleeding, this intra-uterine douche should be given quite hot (115° F.), and creolin should be preferred on account of its hemostatic property. If an anesthetic is not administered, hot water is very painful, and lukewarm water is preferred, except to check hemorrhage.

Some obstetricians pack the uterine cavity with iodoform gauze. In obstetric cases, which alone concern us here, the writer prefers the introduction of an iodoform suppository:

℞	Iodoformi,	ʒv;
	Amyli,	ʒss;
	Glycerini,	fʒss;
	Acaciæ,	ʒj.—M.

Ft. suppositoria No. iij, of the size and shape of the little finger.

The use of such a suppository renders frequent repetition of the intra-uterine douches superfluous. As a rule, the suppositories are used only once in twenty-four hours.

The suppository is introduced through a bivalve speculum by means of a forceps having a curvature like that of the uterine sound. A common dressing forceps is unsuitable for this purpose, as it does not penetrate far enough and it is apt to wound the uterus. Sometimes it is unnecessary to repeat the intra-uterine treatment, the condition of the patient being satisfactory. Vaginal douches are used instead, and they are also employed as a supplement to the intra-uterine injections. They are given every three hours.

Before emptying the uterus it is a good plan first to wash it out with several liters of boiled water, which washing removes a great many microbes that otherwise might be carried into the tissues with the nails or the curette, causing a chill followed by fever. The effect is merely mechanical, and the result in preventing chills and fever is just as good with plain sterilized water as with solutions of bichlorid of mercury, carbolic acid, or lysol.[41]

If several days have elapsed since the infection took place, Bumm recommends the use of the curette. Under such circumstances he states that packing with iodoform gauze is much to be preferred to injections. The gauze keeps the uterus dry and prevents the propagation of putrefaction. In septic infection—that is, when the microbes at work are of the pathogenic kind—these measures become much more unreliable.

In regard to intra-uterine injections opinions vary much among leading obstetricians, and upon the whole the tendency is rather to restrict their use considerably. Pippingsköld of Helsingfors, Finland—who has, or at least during four years from 1884 to 1887 had the smallest mortality the writer ever saw mentioned, namely, 0.29 per cent.—uses them only once or twice a year in a service varying from five hundred to eight hundred patients per annum.[43] Schrader condemns them altogether, because they provoke uterine contractions, and thereby a rapid circulation of lymph, which promotes general infection.[44] According to Bumm, the intra-uterine injections are good in putrid endometritis, and even in the septic form if the microbes have a low degree of virulence, in which case the process remains local; but in other cases they do more harm than good.

The virulent microbes rapidly invade the tissues. In cases of infection from another puerpera or from a patient affected with erysipelas, diphtheria, phlegmon, etc., the local treatment comes too late. When there are clinical signs of absorption—pelvic peritonitis or metastases—local treatment is useless, and it may do harm by inflicting new wounds, by tearing open agglutinated ones, by disturbing beginning encapsulation of septic foci, by causing the displacement of infected thrombi, etc.[45] Frank uses 6 to 8 liters to wash out a uterus.[46] Kroenig found that in septic infection there were as many streptococci a few hours after intra-uterine antiseptic injections as before, and that their virulence, tested on rabbits, was undiminished.[47]

The writer has in not a few cases found that temperature rose after each intra-uterine injection, and that the patients did better without any local treatment except cleansing vaginal douches.

Tamponage with iodoform gauze may occasionally be valuable. Thus a case is reported in which the placenta had been retained for eight days. When the doctor found he could not remove it he tamponed the uterus. The following day he removed a part of the placenta with the curette, tamponed again, and the next day removed the remainder of the placenta with the curette.[48] The gauze ought to be removed soon, but not all at once, since the uterus cannot contract in proportion.[49]

Involution is promoted by the administration of ergot and the application of the faradic current, both poles being applied externally, one at the fundus, the other alternately at both sides just above the pelvic brim.

Inflammation, and especially pain, are combated by means of an ice-bag placed on the abdomen just above the symphysis. To avoid local freezing four layers of muslin should be laid between the bag and the skin. Instead of the ice-bag there may be used a rubber coil through which ice-water is made to circulate. The ice-bag or the coil is to be kept on continually day and night.

Cold is preferable to heat, as it is more soothing, abridges the course of the disease, and perhaps even has some direct antiseptic value, certain microbes being restrained from developing,[50] while a moist warm application offers the very best chances for the development of all lower life. If, however, cold is contra-indicated, as in diarrhea, low vitality, puerperal diphtheria, etc., warm flaxseed-meal poultices should be placed on the abdomen.

When the disease enters on a more subacute stage, the writer uses a Priessnitz compress; that is, a towel wrung out of cold water, placed on the abdomen, and covered with some waterproof material. The pad becomes warm in a quarter of an hour, and is renewed four times a day. This transition from cold to heat is a very powerful absorbent, and it is well liked by patients. Internally there are given 5 grains of quinin four or six times a day, small doses of an opiate *pro re nata*, and a moderate amount of stimulants.

If inspection of the cervix shows diphtheritic patches, the treatment is much more energetic; then the whole cervix up to the os internum is cauterized with the above-mentioned solution of chlorid of zinc, the uterus is washed out with antiseptic fluid, and there is left in it an iodoform suppository. These injections are repeated once in twenty-four hours, and a new suppository is introduced. This treatment is continued until all sloughs are thrown off and fever has ceased. Large and frequent doses of strong stimulants should be given—at least half an ounce of whiskey or of brandy every two hours.

Digitalis may be needed as a heart tonic, preferably in the form of the officinal infusion (℥ss, four times a day); but if the patient cannot swallow or vomits the medicine, the tincture may be injected hypodermatically in doses of from 5 to 10 minims, repeated according to circumstances. Tincture of

strophanthus in doses of 5 or 6 minims is also an excellent heart tonic. Quinin is given in moderate doses, not with a view of reducing the temperature, but as a tonic and antiphlogistic.[51] Large doses of strychnin (gr. $\frac{1}{20}$–$\frac{1}{10}$) and nitroglycerin (gr. $\frac{1}{100}$–$\frac{1}{25}$) are also useful.

In *dissecting metritis* the process of elimination is furthered by intra-uterine douches of creolin, lysol ($\frac{1}{2}$ of 1 per cent.), or a saturated solution of boric acid. All intra-uterine injections should be warm, as a cold fluid sometimes causes collapse.

Putrescence of the uterus is a condition that has disappeared from all well-ordered lying-in institutions since strict aseptic or antiseptic treatment has been introduced. If a case should come under the observation of the writer, he would treat it with lysol injections, iodoform suppositories, alcohol, quinin, and albuminoid food.

Unguentum Credé, an ointment containing silver in a soluble form, and used in the dose of 45 grains for inunction on parts of the body where the skin is soft, thin, and free from hair,—for instance, the inside of the arms, of the thighs, and the chest,—once a day, has been praised and may be tried, but has not been successful in the writer's hands. Of late, Credé has brought out his soluble silver, *collargolum*, *argentum solubile Credé*, or *argentum colloidale*, in a form which can be dissolved in distilled water and injected under the skin or into a vein. A 1 per cent. or $\frac{1}{2}$ of 1 per cent. solution is used. Usually from 5 to 10 grams (ℳlxxv–℥iiss) of the stronger and 10 to 20 grams (℥iiss–v) of the weaker are injected. The writer tried it in a promising case. The temperature was rapidly reduced, but the patient died.

The injection of Marmorek's *anti-streptococcus serum* has been used extensively, but has given so large a mortality that there is reason to believe that it is not only useless, but does positive harm. It has been condemned by the committee appointed by the American Gynecological Society for the purpose of reporting on it.* The same committee declares the curette to be a most dangerous instrument in the treatment of streptococcic endometritis. It disapproves of hysterectomy in the acute stage of puerperal infection. It says that such cases tend to recover and mortality is less than 5 per cent. if nature's work is not undone by too energetic local treatment.

A valuable addition to our therapeutical resources seems to have been secured in *nuclein*, a substance obtained from yeast. It is given either hypodermatically (ℳx, twice a day, increasing by ℳv daily) or by the mouth (ℳxxx–℥j). These doses refer to the nuclein solution prepared by Parke, Davis & Co. The object is to produce an artificial leucocytosis, the leucocytes being expected to incorporate the microbes and render them harmless. Clinically this remedy has a good effect on secretions, ulcers, and the general condition of the patient. It is apt to cause pain in the bones, especially the tibiæ, which disappears within a week, and in so serious a disease such small drawbacks ought to have little weight.†

* *Transactions Amer. Gyn. Soc.*, 1899, vol. xxiv., p. 104.

† J. Hofbauer, *Centralbl. f. Gynäk.*, 1896, No. 17, vol. xx., p. 441.

Hypodermoclysis is also a resource well worth trying in severe cases of puerperal infection. When done aseptically, there is no objection to it at all, and it is simple to perform. One or two pints of warm normal salt solution (chlorid of sodium 6 : 1000) are injected under the skin in places where there is much loose connective tissue, especially the region between the collar-bone and the breast. It can either be pumped in with the writer's apparatus for transfusion or infusion (Fig. 134),* or pressed in by gravity by attaching a needle to a fountain syringe. While the water fills the tissues, they should be massaged, so as to promote absorption and make room for a new supply. If desired, the process may be repeated daily or oftener. The water goes through the whole system and is eliminated by the kidneys, thus furnishing, as it were, an internal bath by which noxious substances may be removed from the tissues. By combining this measure with large, high enemas of soapsuds or normal salt solution the effect is still increased.

Some prefer to lay open a vein at the elbow and inject the fluid directly into the vessel, which has a more expeditious effect, but is not so simple in

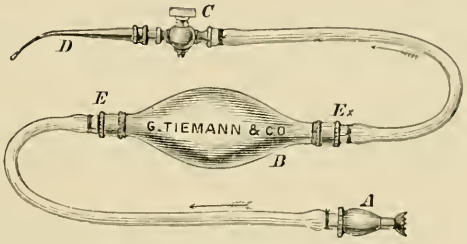


FIG. 134.—Garrigues' transfusion dilator: *A*, plunger; *B*, bulb; *C*, stopcock; *D*, flexible probe-pointed canula; *E*, *E*, valves.

execution. My apparatus has both needle for hypodermic use and canula for intravenous injection.

Hysterectomy has been performed with the aim of removing the source of infection, but if the operation shall help, it must be performed before the microbes have invaded the general system or, as a distinguished advocate of the method has said, within a day or two after confinement. At that time it is, however, hard to tell whether or not the invasion will take place, so that one may say the operation will be performed either too early or too late. A uterus should certainly not be cut out if the patient can recover unmutilated, and if septicemia is well established the operation will not avert, but may even hasten, a fatal issue. The writer's personal experience with hysterectomy in puerperal cases does not warrant him in recommending it.

Cellulitis and Adenitis are treated with the ice-bag, hot douches, and opium, and later with the Priessnitz compress. If the resolution is unduly slow, the abdominal wall over the swelling should be painted once a day with tincture of iodin. After this application has been repeated for a few days, and the epidermis has become hard, the writer covers the abdominal wall with a piece of lint soaked in the following wash :

* Garrigues, *Apparatus for Transfusion*, *Amer. Jour. Obst.*, Oct., 1878, vol. xi., No. 4, p. 754.

℞. Acidi carbolici, ʒj;
Glycerini,
Aquæ, āā. ℥iij.

This preparation softens the epidermis, prevents cracking, and promotes absorption of the iodin.

When the tenderness has been so much reduced that a speculum may be used, it is well to combine the external painting with that of the vaginal vault, and thus bring the iodin in more direct contact with the affected part. This application is repeated every three days. Care should be observed to take so little of the tincture on the brush or applicator that it does not trickle down to the vulva, where it burns, while it is not felt at all on the fornix. In ambulant patients it is well to wipe off the redundant tincture with absorbent cotton before they rise from the table.

If suppuration sets in, it should be hastened by means of warm flaxseed-meal poultices; when the abscess is formed it should be opened with the knife through the skin or the vagina, or both. If there is any doubt as to the presence of pus, it may be settled by using a hypodermic syringe or an aspirating needle. The common hypodermic syringe is too short, but one may

Fig. 135.—Exploratory vaginal syringe.

be made having an attachment to the case and the piston (Fig. 135).* If there is pus, the needle may be used as a guide for the knife. The incision must be made behind a line drawn transversely through the cervical canal, in order to keep clear of the ureter and the uterine artery. The surgeon

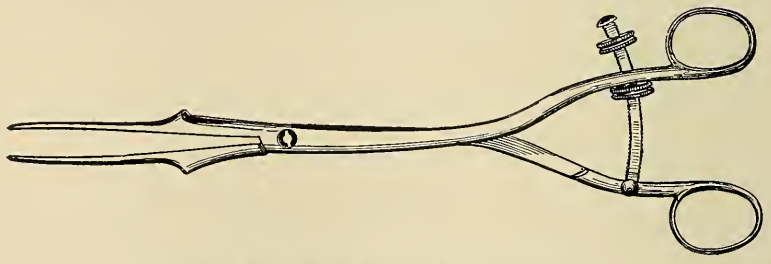


Fig. 136.—Garrigues' blunt expanding perforator.

should likewise feel for and avoid vaginal arteries. Often one or more drainage-tubes are inserted.

If the abscess points above Poupart's ligament, the incision should be made there, parallel to the ligament. Then a finger should be introduced,

* A very satisfactory instrument of this kind has been made for the writer by Mr. Campbell, cor. Lexington Ave. and Thirty-fourth Street, New York.

and, if the bottom is felt to be near the vaginal vault, an opening should be made here and through-drainage established with a rubber tube with side holes.

If the abscess, on the other hand, is within reach from the vagina, the writer makes a transverse incision behind the cervix, separates the tissues bluntly from it, places the index-finger on the abscess, and perforates it with

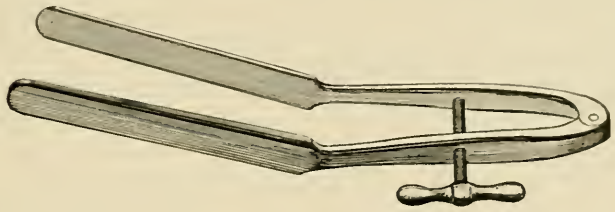


FIG. 137.—Boldt's expanding dilator.

a blunt-pointed expanding perforator (Fig. 136). After letting out the pus, the opening is enlarged with Boldt's expanding dilator (Fig. 137). If there is any bleeding, the cavity is packed with iodoform gauze. If not, a skyrocket drainage-tube of soft rubber (Fig. 138) is inserted. It consists of a short, thick tube with lateral openings, and a long, thin one without side holes, stitched together. After the abscess has been opened from the vagina,

FIG. 138.—Skyrocket drainage-tube.

the tube is introduced and the lower end of the short tube is fastened to the edges of the wound with four silver wire or silkworm-gut sutures. The long tube is used for injecting antiseptic fluid, which returns through the short.

If the abscess is small, a single or double drainage-tube with cross-bar (Figs. 139, 140) may be left in.

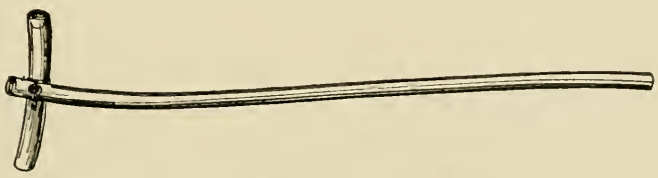


FIG. 139.—Single soft-rubber drainage-tube.

Abscesses in the subcutaneous or subfascial connective tissue should be opened and treated according to the rules of antiseptic surgery.

These operations should be performed with full antiseptic precautions. The best way of disinfecting the vagina is to pour tinctura saponis viridis into it and rub it with absorbent cotton or gauze held in a long forceps, and

to irrigate with corrosive-sublimate solution (1 : 2000) followed by lysol (1 : 100).

If an abscess communicates with the intestine and does not close, a counter-opening should be made in the abdominal wall or in the vagina, and drainage be established to this organ. If a fistulous tract remains leading from the pelvis to the vagina or the skin, and the patient's life is in danger from

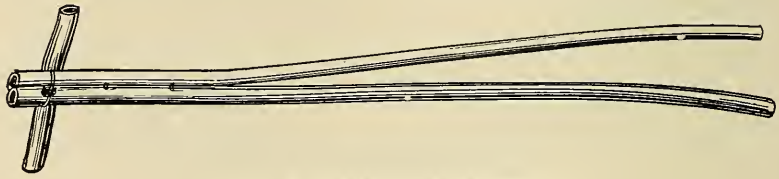


FIG. 140.—Double soft-rubber drainage-tube.

exhaustion, a cure may yet be accomplished by vaginal hysterectomy, with or without salpingo-oöphorectomy, but the operation may be a very difficult undertaking. The internal treatment is the same as stated before.

Lymphangitis.—Lymphangitis of the vulva and the groin is treated with compresses soaked in a lead-and-opium wash:

℞. Tincturæ opii, ℥ss;
Liquoris plumbi subacetatis diluti, q. s. ad ℥viij.—M.
Sig. For external use.

If the inflammation runs into suppuration, the treatment is the same as that above described for suppurative cellulitis. Lymphangitis of the uterus is treated with ice-bags, opiates, saline aperients, quinin, and alcohol.

Salpingitis and Oophoritis.—These localizations are treated in the same way as lymphangitis of the uterus. When, from the persistent fever, the pain, the sensitiveness on pressure, the swelling, we may infer that abscesses have formed in them, these should be opened in the way described for cellulitis. The author has had most excellent results from this operation, but also failures. He has opened and drained as many as five separate collections in one individual. Before operating we should give nature plenty of time to wall off the abscesses from the peritoneal cavity.

According to Dr. Leon F. Garrigues,* the tube and ovary may be reached by separating the two layers of the broad ligament, and punctured without entering the peritoneal cavity, which would be a great advantage.

Salpingo-oöphorectomy should be undertaken only in the rare cases where the appendages are situated so high up that they cannot be reached from the vagina. The prognosis is bad.

Peritonitis.—Opinions are much divided as to the advisability of using antiseptic intra-uterine injections in peritonitis. Personally, the writer gives

* L. F. Garrigues, "A New Method for Retroperitoneal Drainage of Pyosalpinx," *Medical News*, May 26, 1900.

one injection, on the assumption that besides the microbes which already have found their way from the uterus to the peritoneal cavity, and which are beyond reach, there may be others in the uterine cavity which it may be advantageous to remove. The writer has never seen any bad effect from this practice, while sometimes it seemed to do good.

The abdomen is covered with two large ice-bags, whose weight is diminished by suspending them from a cradle. Instead of the ice-bags, a rubber coil with circulating ice-water may be employed. It is only when the above-named counter-indications against ice are present that a warm flaxseed-meal poultice should be substituted.

A remedy of the greatest value in puerperal peritonitis is opium, given in as large doses as the patients can stand—and they can stand enormous doses—the only indication to stop being the condition of the respiration. It is perfectly safe to give the drug in doses repeated at short intervals until the respiratory movement sinks to 14, or even to 12, per minute. The best opiate for this purpose is morphin. To relieve pain as promptly as possible it is well to begin with a hypodermatic injection of a quarter of a grain of the drug. Afterward it is better to give the medicine by the mouth, because too many injections would be needed; because they ought only to be given by the doctor; because the medicine is brought directly to the affected part; and because hypodermatic injections, if not given with the greatest care, disinfecting both the instrument and the skin, are apt to cause abscesses which may prove a serious, even fatal, complication. In this way $\frac{1}{8}$ to $\frac{1}{4}$ grain is given every half hour until the patient is fully under the influence of the drug—that is to say, is free from pain, and yet not in a deeper narcosis than that she can easily be aroused.

Lawson Tait pointed out the danger of using opiates after laparotomies, and the advantages of moving the bowels. This treatment, which undoubtedly is a great advance in gynecology, should, in the writer's opinion, not be applied to puerperal peritonitis. In the writer's younger years the treatment with aperients was in vogue, and he is still harassed by the memory of the poor tortured women who were plied with senna and were given insignificant doses of opium. With that plan the mortality was much greater. With the "opium plan" he has saved one-half of the cases affected with diffuse peritonitis.[53] Others have, however, diametrically opposite views on this subject. Gottschalk, for instance, keeps the bowels open and rarely uses opiates.[54]

If morphin has too depressing an effect, especially if the heart is weak, atropin may be added to the morphin. By adding 1 part of atropin to 1000 of Magendie's solution the latter may be given according to the above rule:

℞. Atropinæ sulphatis, gr $\frac{1}{8}$;
Solutionis morphinæ (Magendie), ʒij.—M.
Sig. Four to eight minims as prescribed.

Alcohol should likewise be given in very large doses, from half an ounce to one ounce every two hours or oftener. The writer gives quinin in the mod-

erate dose of 5 grains every four hours, which periods of administration keep up the influence of the drug continually.

No aperient medicine is given. An evacuation takes place from time to time spontaneously, and if it does not an enema is given. Pure glycerin (℥ij–℥j) may be used. The hygroscopic property of the glycerin attracts much fluid, softens scybala, and lubricates the passage. Another good rectal injection is composed of a quart of flaxseed-meal tea with a tablespoonful of castor oil and a teaspoonful of oil of turpentine. A still more powerful enema is made of inspissated ox-gall (a teaspoonful) or fresh gall (a tablespoonful), glycerin and castor oil (a tablespoonful of each), table salt (a heaping teaspoonful), and flaxseed-meal infusion (a tablespoonful to a quart of water).

Frank has seen excellent results from the subcutaneous injection of pure creasote 3 grams (45 minims) *pro die*, or from an emulsion of creasote and oleum camphoratum, *āā.* half a gram (8 minims), beginning with 0.5 gram morning and evening, and increasing the dose gradually. The injection is made deeply into the gluteal region or into the muscles of the spine.[55]

Occasionally digitalis or strophanthus may be used as a heart tonic, and strychnin is employed as a general tonic, especially as a tonic for the respiratory organs. When used as a respiratory stimulant the hypodermatic method is preferable.

For vomiting cocain and hydrocyanic acid are the best remedies. The hydrochlorate of cocain may be given by the mouth or hypodermatically (gr. ¼, repeated every two hours). The hydrocyanic acid the writer gives by the mouth in the following mixture:

℞. Acidi hydrocyanici diluti, ℥ss;
Acidi citrici,
Sodii bicarbonatis, *āā.* ℥ij;
Syrupi rubi Idæi, ℥ss;
Aquæ destillatæ, q. s. ad ℥vj.—M.
Sig. A tablespoonful every one, two, or three hours.

An ice-bag placed over the pit of the stomach is also useful in restraining vomiting.

The diet consists of milk, beef-tea, and oatmeal gruel. The beef-tea may be made of fresh minced meat, which is put into a bottle with just water enough to touch all the meat, the water being acidulated by adding a little dilute hydrochloric acid. The bottle is corked and boiled for an hour in a pot with water. This beef-tea makes a very strong, nourishing, and stimulating food, which is taken with a teaspoon. If more bulk is desired, the beef-tea is prepared by taking a pound of minced beef, a teaspoonful of dilute hydrochloric acid, and a pint of cold water. This mixture is left for an hour or more, and is stirred every quarter of an hour; it is then placed over the fire, and is taken off as soon as it reaches the boiling-point. It is strained

through a cloth, and salt is added to taste. The beef-tea may also be made with the different prepared extracts, such as those of Valentine, Armour, Mosquera, or Liebig, but they contain chiefly kreatinin and little albuminoids. Max Runge and his followers give even solid food—eggs, veal cutlet, and ham.[56]

To give an idea of the amount of morphin, alcohol, and food that may be administered, the writer may mention that one of his patients who recovered took in twenty-three days 216 grains of morphin, 228 ounces of whiskey, 1078 ounces of milk, and 418 ounces of beef-tea, making an average of 9 grains of morphin, 9½ ounces of whiskey, 45 ounces of milk, and 7½ ounces of beef-tea in twenty-four hours. The greatest amount of morphin given in one day was 13¾ grains.

Many obstetricians make extensive use of antipyretic remedies—large doses of quinin, salicylate of sodium, antipyrin, antifebrin, phenacetin; others are strenuously opposed to their use, and the writer belongs to the latter category. These drugs rather mask than cure the disease. Some of them—salicylate of sodium and antipyrin—are particularly objectionable, because they weaken the patient. The best is phenacetin (gr. v every four hours), since it lowers the temperature, combats pain, and does not to the same degree weaken the heart. In this class may be reckoned carbolic acid, which the writer has given with good effect in cases of offensive diarrhea:

℞. Acidi carbolici purissimi,
Liquoris iodi compositi, āā. ℥xvj;
Mucilaginis acaciæ, fl.℥ij;
Syrupi aurantii, ℥ss;
Aquæ destillatæ, q. s. ad ℥viij.—M.
Sig. A tablespoonful every hour.

The best way of reducing the high temperature is the external application of cold. In addition to the ice-bags on the abdomen an ice-cap may be placed on the head, for which purpose some are made in the shape of a helmet. It is grateful to the patient to be washed over the whole body with equal parts of alcohol and cold water, but this has a more refreshing than a really antipyretic effect. The latter is obtained by a Kibbee fever-cot, the cold pack, or the cold bath. The fever-cot consists of a wooden frame having a network of cord, under which is a rubber sheet forming an inclined plane toward one end of the cot, where a water-pail is placed. A folded blanket is laid over the netting to protect the patient against being cut by the cords, and a rubber-covered pillow is laid at the head of the cot. A folded sheet is laid across the middle two-thirds of the cot, the patient being so placed that this sheet reaches from her armpits to the trochanters. Her clothes are drawn up, and her legs are covered with woollen stockings and a blanket. Bottles containing hot water may be placed against the soles of her feet. The sheet is folded over the patient's chest and abdomen, and water is

poured gently from a pitcher over the sheet, beginning with water at a temperature of from 85° to 90° F., and gradually diminishing it to from 75° to 80° F. This application is continued for a quarter of an hour, when the patient is covered up. At the end of each hour the procedure is repeated if the temperature again rises.

Where the fever-cot is not obtainable the cold pack may be substituted in the following way: Two beds are each covered with a rubber or an oil-cloth sheet, over which is placed a blanket, and over the blanket is laid a muslin sheet wrung out of cold water. The patient is placed on the wet sheet, which is wrapped around her except at the feet. If the circulation is bad, hot-water bottles or hot-water bags may be placed against the soles, one or two blankets being laid over the patient. At the end of ten minutes she is removed to the second bed, where the same procedure is repeated. Four or six such packs may be needed to reduce the temperature as much as is wanted, and the handling of the patient may cause her pain and necessitates the help of three nurses.

The patient is less disturbed by the cold bath, which is a powerful refrigerant, and which should be given in the following manner: A bath-tub is filled with water slightly below blood-temperature, into which bath the patient is gently let down, carrying her on the sheet of the bed upon which she has been lying. The water is then gradually cooled by withdrawing warm and substituting cold water, until it reaches 80° F. It is well to give the patient a tablespoonful of brandy before the bath, and she must be watched carefully by the physician while she is in the bath; at any sign of collapse she should be removed from the bath; otherwise she may remain in it for fifteen or twenty minutes.

In local and even in diffuse peritonitis, if milder remedies have not the desired effect, laparotomy may be resorted to. Several cures under such circumstances have been reported.[57]

By turning out the large curdled masses and the sero-fibrinous or purulent fluid, washing out the peritoneal cavity with peroxid of hydrogen, and leaving gauze drains for further escape of the fluid or gas, it would seem that we increase the chances of the patient; but if we want to operate at all, we should not wait until her whole system is poisoned and death is imminent.

Still, as some patients recover by medicinal treatment, and since in fatal cases the operation may seem to have caused the death of the patient, recourse to laparotomy has so far been rather limited during the acute stage of the disease. If the patient gets over this stage and there are left encysted peritonitic exudations, the operation ought to be performed.

Dr. W. R. Pryor recommends curettage of the uterus, irrigation with salt solution, packing with iodoform gauze, a broad incision into Douglas' pouch, the liberation of all adherent organs, the evacuation of all fluids, and the application of a Mikulicz tampon of iodoform gauze filling the pelvis.* While this method appears to be the best as long as the inflammation is sit-

* W. R. Pryor, *Trans. Amer. Gyn. Soc.*, 1899, vol. xxiv., p. 111.

nated below the pelvic brim, it does not suffice when the exudation is found in the abdominal cavity. Then the choice lies between laparotomy and medicinal treatment, with hardly any appreciable difference as to prognosis.

Pleurisy.—If the infection locates in the pleura, producing pleuritis, there should be applied to the chest an ice-bag, which is not only very effective in soothing the pleuritic pain, but also abbreviates the course of the disease. If, however, the affected part cannot be reached, warm applications should be preferred, either flaxseed-meal poultices or spongiopiline—that is, a piece of gutta-percha-covered felt, which only needs dipping into hot water.

In the exudative form of pleurisy tincture of iodin may be painted on the skin. Internally, the iodid of potassium and diuretics are given, for example:

℞. Tritici repentis radicis decoctionis, ℥ss–℥viij;
Potassii acetatis,
Potassii bitartratis,
Potassii citratis, āā. ʒj.—M.
Sig. A tablespoonful from four to six times a day. Shake well.

The amount of fluid in the pleural cavity is rarely large enough to call for thoracentesis by aspiration. If the fluid becomes purulent, the empyema should be operated on by resection of a piece of a rib.

Pneumonia.—When the lungs become inflamed, the chest should be covered with large warm flaxseed-meal poultices well protected with oiled muslin, and a flannel binder with shoulder-straps of flannel. These poultices need not be changed more than four or six times in twenty-four hours. Stimulants and tonics are highly indicated. A favorite prescription of the writer is citrate of ammonia, obtained by mixing the carbonate with citric acid:

℞. Ammonii carbonatis, ʒij.
Div. in chart. No. xij.
Sig. No. 1, one powder four times a day.

℞. Acidi citrici,
Sacchari albi, āā. ʒij.—M.
Div. in chart. No. xij.
Sig. No. 2, one powder four times a day, mixed with No. 1.

Perhaps this preparation serves to dissolve the fibrinous exudation, or perhaps it only acts as a stimulant. Care should be taken to change the position of the patient to prevent stagnation of blood by gravitation. If edema supervenes, dry cupping is valuable. Inhalation of oxygen may enable the patient to ride out a storm. Of late, creosotal is much used (♏x in capsules every four hours).

Endocarditis and Pericarditis.—If the pericardium is inflamed, the treatment consists in the same external applications and diuretics as those recommended for pleuritis. The inflammation of the endocardium is hardly within

reach of therapeutic measures. Ice-bags, digitalis, and strophanthus may, however, be tried.

Enteritis.—Offensive diarrhea is best combated with internal antiseptics—a minim of carbolic acid in a mucilaginous menstruum, repeated every hour, combined or not with the same amount of liquor iodi compositus; naphthalin (gr. ij–vij every two hours); or salol (gr. v every two hours). Enemas with a teaspoonful of starch and 25 drops of laudanum give great relief when the patient suffers from tenesmus. A heaping teaspoonful of subnitrate of bismuth may be added to advantage.

Hepatitis.—Pain in the right hypochondrium may be relieved with an ice-bag or with a flaxseed-meal poultice. If the bowels are constipated, calomel (gr. v–x) is preferred as an aperient on account of its cholagogue properties.

Nephritis.—A warm flaxseed-meal poultice, or a bag with digitalis leaves dipped in hot water, is placed under the loins. Diuretics are given (see *Pleurisy*). Small doses of chloral hydrate (gr. xv–xx one to three times a day) diminish the albumin in the urine. Chlorid of iron may be given in the following form:

℞. Tincturæ ferri chloridi, ℥ss;
Syrupi simplicis, ℥j;
Aquæ, q. s. ad ℥viij.
Sig. One tablespoonful four times a day.

To protect the patient's teeth she should be directed to gargle with a solution of sodium bicarbonate (ʒij–℥viij) after taking the medicine. Warm baths are useful.

If uremic symptoms appear, elimination through the skin and the intestine must be attempted. To accomplish elimination through the skin the most powerful means is a hot-air bath, which may be obtained by placing an alcohol lamp under a chair beside the bed, an open umbrella over the abdomen of the patient, and then covering both with a waterproof. Perspiration, however, is weakening, and it ought not to be prolonged over two hours.

Free evacuation of the bowels should be obtained by the most powerful drastic purgatives, such as croton oil (½ drop every half hour) administered in pill form or in castor oil or in almond oil, or, if the patient cannot swallow, mixed with butter and rubbed on the tongue; common elaterium (gr. ¼–½ every hour); Clutterbuck's elaterium (gr. ⅛), elaterin (gr. $\frac{1}{16}$–$\frac{1}{12}$), or gamboge (gr. 1 every half hour).

The diet should consist exclusively of milk, either in its natural state, or peptonized, or as koumiss, or as matzoon, or zoolak. These preparations of milk should be given only in small quantities (tablespoonful or even teaspoonful doses), and if even these cannot be retained recourse should be had to rectal alimentation with Leube-Rosenthal's solution, Rudisch's beef-peptonoids, or an egg with half an ounce of brandy and 3½ ounces of milk.

Vomiting is combated by hydrocyanic acid, cocain (see *Peritonitis*), bismuth,

strychnin, tincture of iodin, carbolic acid, creasote, or lumps of ice, and an ice-bag or a turpentine stupe applied to the pit of the stomach.

Encephalitis and Meningitis.—If localization takes place in the brain or its envelopes, little is to be expected of therapeutical measures. The head should be covered with the above-mentioned ice-cap or an ice-water coil. The bowels should be kept loose. Ergot and liquor barii chloridi (♏v q. 4 h.) may be given, besides quinin, with a hope of causing contraction of the cerebral blood-vessels and checking the migration of white blood-corpuscles.

Delirium, restlessness, and insomnia are quieted by bromids, chloral, cannabis indica, opiates, sulphonal, or trional.

Arthritis.—If localization takes place in a joint, it should first of all be immobilized by proper splints and bandages, but in such a way as not to interfere with other treatment. In the beginning an ice-bag applied around the inflamed joint has often an excellent effect. Later, tincture of iodin or fly-blisters may serve as counter-irritants. If the effusion becomes purulent, the joint should be emptied with the aspirator-needle and be injected with a solution of carbolic acid (3 to 5 per cent.), creolin (2 per cent.), or peroxid of hydrogen. If this treatment does not suffice, the joint should be laid open by a free incision.

Skin.—Puerperal cutaneous eruptions hardly call for special treatment. If they itch, considerable relief may be obtained from bathing the skin with the following solution of carbolic acid:

℞.	Acidi carbolici,	ʒss;
	Alcoholis,	
	Glycerini,	āā. ℥ss;
	Aquæ,	q. s. ad ℥vj.

Bed-sores should be treated very carefully. As soon as the skin becomes red over the sacrum, the trochanters, the heels, or other places exposed to pressure, the patient should be placed on suitable rubber air-cushions, and so far as possible be shifted so as not to press on the affected spot. Under the heels are placed rubber rings filled with air, or a similar contrivance is improvised by winding a strip of muslin in a spiral line along a wad of oakum, thus forming an elastic ring into the opening of which the heel fits. The red spot is bathed frequently with lead-water.

If there is an excoriation, it should be dressed with glycerite of tannin (ʒj to ℥j) or with the iodoform-balsam ointment (p. 241).

If gangrene has developed, the dead tissue should be removed with knife or with scissors as soon as a line of demarcation has formed, and the sore should be dressed with lint or cotton dipped in a 10 per cent. camphor emulsion or a 2 per cent. creolin emulsion:

℞. Camphoræ, ℥ss;
Mucilaginis acaciæ, ℥j;
Aquæ, q. s. ad ℥v.—M.
Sig. Shake well. For external use.

When once the hole is filled by granulation the above-mentioned milder remedies or dermatol may be substituted.

In severe cases much benefit is derived from placing the patient on a water-mattress, which adapts itself very evenly to the whole lower surface, and facilitates changes in position by the ease with which the water flows from one part of the mattress to another.

Phlebitis.—1. *Phlegmasia Alba Dolens.*—The affected limb should be painted once a day with tincture of iodin along the swollen veins, and be surrounded by cotton batting, slightly compressed with roller bandages, and elevated on cushions, so as to favor reflux of venous blood and lymph and to prevent stagnation and congestion. In protracted cases blue ointment may be substituted for the tincture of iodin, but to prevent tearing off a piece of a thrombus, which would form an embolus, the ointment should be melted with equal parts of olive oil and painted on the skin with a brush. As there is great tendency to relapse, the patient should be kept quietly on a lounge or in an easy-chair with raised extremity for a fortnight after the swelling has subsided. Circumscribed abscesses must be opened and be dressed antiseptically, and in cases of diffuse subfascial phlegmon several long incisions should be made at an early date to limit the destruction in the deeper parts.

2. *Inflammation of Varicose Veins.*—If varicose veins become inflamed, the limb is immobilized, and covered with cloths dipped in a lead-and-opium wash. The cloths are kept cool by evaporation and addition of new fluid or by changing them. If the cool application meets with objection, flaxseed-meal poultices may be substituted. After the acute stage has passed the limb is slightly compressed with a roller bandage, and when the patient begins to walk about the bandage is replaced by an elastic stocking.

3. *Uterine Phlebitis* calls for all the general and local treatment described in the preceding pages, especially quinin, alcohol, ice-bags or warm poultices, and hot vaginal douches. With some obstetricians hysterectomy is particularly indicated in this form of puerperal infection.

Acutest Septicemia.—In those cases in which the infection takes such a rapid course that no local inflammations have time to develop there is scant hope of saving the patient's life. We should, however, try to better her chances by following the principles laid down above. High temperature should be lowered by cold baths and local refrigerating applications. The patient's strength should be kept up by the administration of alcohol, quinin, strychnin, atropin, digitalis, and strophanthus. Pain and restlessness should be subdued with hypodermatic injections of small doses of morphin. Frank's injections of creosote may be tried. Thierry, of Rouen, claims to have obtained recovery in ten cases of the most severe septicemia without localization, after

having failed with everything else, by means of oil of turpentine injected subcutaneously in gram doses. It forms an abscess, and in one case he produced even as many as three abscesses.[59] Credé's ointment and nuclein should be tried.

Looking back over the whole field and weighing the evidence adduced by different observers, the author is inclined to think that surgical interference, exclusive of mere opening of abscesses and Porro's operation, but inclusive of intra-uterine douches and curetting, has done more harm than good when directed against puerperal infection. Krönig, in Germany, and Whitridge Williams, in America,* have, by mere stimulating and tonic measures and diet, had a mortality of only 4 and 4⅓ per cent. respectively in cases of streptococcus infection, which by all is declared to be the most dangerous. This does, of course, not preclude the possibility that in the hands of men with exceptional judgment and skill, operations sometimes will save the lives of patients who otherwise would be lost.

2. Thrombosis of the Lower Extremity.

The veins of the lower limb often become thrombotic even during pregnancy. The superficial veins of the calf are particularly liable to be affected in this way. During the puerperium such thrombi may increase in extension or new ones may be formed.

Etiology.—Varicose veins are more easily affected than healthy ones. The pressure of the pregnant uterus on the vena cava and the iliac veins interferes with the free circulation of the blood and thus favors stagnation and the formation of a thrombus. The long rest after delivery is also a predisposing element.

If there has been much hemorrhage, the blood becomes more coagulable. Fever may have weakened the heart and deprived it of some of its propulsive power. If pelvic exudation has taken place, the exudate may press on the veins.

Symptoms.—The primary thrombosis of small veins gives rise to no symptoms, or at most a slight pain. If the large veins, such as the femoral or the saphenous, are affected, the leg becomes edematous, the swelling beginning at the foot and extending upward.

Diagnosis.—In *phlegmasia alba dolens* the swelling begins from above.

Prognosis.—The prognosis is in general good. The thrombus becomes reabsorbed or forms a solid cord of connective tissue. There is no tendency to disintegration, as in infectious thrombosis. But there is the possibility of a part of the coagulum being broken off and forming an embolus. Rarely the irritation caused by the thrombus leads to phlebitis, periphlebitis, and an abscess breaking through the skin. If many veins are obstructed, gangrene may ensue, with loss of the foot or the leg.

Treatment.—The limb should be raised on cushions, kept quiet, and treated as described above under phlegmasia alba dolens.

* J. Whitridge Williams, *Trans. Amer. Gyn. Soc.*, vol. xxiv., p. 97.

3. Subinvolution.

By subinvolution is meant the retardation or arrest of the processes by which the uterus is returned to its normal dimensions, position, and anatomical structure after premature termination of pregnancy or subsequent to delivery at term. This anomaly may also be present in varying degree in the ligaments of the uterus, the vagina, and the abdominal walls. Usually in from six to ten weeks the physiological changes known as *involution* have been completed.

Etiology.—Since the physiological changes in the uterus after delivery are brought about by a diminution in its blood-supply, resulting from contraction and retraction of the uterine muscle-fibres, it is obvious that the causes of failure in involution must be sought for in any factor or factors modifying the amount of blood going to the organ or interfering with its firm contraction. Several conditions may obtain in an individual that operate in either the one or the other manner; indeed, not infrequently the one condition will contribute to retard involution both by increasing the amount of blood in the uterus and by interfering with its contraction.

The most frequent condition interfering with normal involution by determining an excess of blood is a change in the endometrium, which change is either hypertrophy occurring in the latter months of pregnancy, or an inflammation developing after delivery, the result of septic infection. Very frequently associated with infection is laceration of the cervix or of the perineum with uterine displacement, together with uterine and peri-uterine inflammatory products. Other causes, much less frequent, are polypoid and interstitial or submucous fibroid tumors, and cardiac and hepatic diseases producing engorgement of the pelvic viscera. Later in the process of involution chronic constipation, assuming the erect posture and engaging in exercise or laborious work, and the resumption of sexual intercourse too soon after abortion or after delivery at term, are causes very likely not only to retard, but even to arrest, involution.

The conditions that may cause subinvolution by interference with the contraction of the womb are usually operative shortly after labor, and therefore their early recognition is important. Of these conditions the most important are large masses of hypertrophied decidua, placental polyps, placentæ succenturiatæ, large blood-clots, and displacement of the uterus. The latter, when it occurs within a few days after labor, is commonly due to a misplaced compress and an injudiciously firm abdominal binder, to an over-distended bladder, or to dragging adhesions. In rare cases an extra-uterine tumor may be discovered. Women who from necessity or desire do not nurse their children are more likely to develop subinvolution—a fact which supports the belief of the close nervous connection between the uterus and the mammary glands.

That constitutional disturbances, independent of any local disorder, may influence the course and progress of involution is by no means certain. The older writers were willing to attribute subinvolution very largely to defective nutrition and to the enervating effects of acute and chronic diseases. That such influence

is exceptional the writer is forced to believe. At the present writing there is under his care, in the last stages of phthisis, a patient whose physical force is at a minimum, yet involution of the uterus has progressed in a perfectly uninterrupted manner. Analogous cases are repeatedly observed. There are individuals, however, in whom there seems to be a general lack of tone: their muscles are flabby; they are indisposed to take any active exercise, and are frequently of gouty or of rheumatic antecedents. Women of this class sometimes have subinvolution associated later with uterine displacement without a distinct local cause. Nevertheless, it is certainly wiser for the obstetrician to search for a local cause in every case than to be content with attributing a failing involution to any constitutional disorder that may complicate the puerperal period.

Diagnosis.—As subinvolution is the starting-point of numerous intrapelvic disorders, it is important that the obstetrician should recognize its presence, and at an early date begin measures to correct the abnormality, since deferred treatment permits an aggravation of the local changes which occur in the early stages, exposes the patient not infrequently to great danger of infection, and, if the latter is safely passed, renders her very liable to subsequent ill health from intrapelvic disorders.

In the early stages of the process of involution abdominal palpation practised at the daily visit will disclose any cessation in the gradual diminution in the size and height of the womb. For practical purposes it may be stated that the fundus uteri on the day following delivery will be found a finger's breadth above the umbilicus; on the third and fourth days, a trifle below the umbilicus; on the fifth and sixth days, two fingers' breadth below the umbilicus; on the seventh, eighth, and ninth days, three or four fingers' breadth above the symphysis; and on the tenth, eleventh, and twelfth days the fundus is usually slightly above, on a level with, or a little below, the symphysis.[60] This process of involution continues throughout the puerperal period, and careful intra-uterine measurements taken at varying intervals up to the tenth and twelfth weeks show a steady diminution up to a point when the dimensions of the involuting womb are really less than those of the unimpregnated uterus. Later, the size of the organ by subsequent engorgement of the uterine vessels is permanently increased to a slight degree. Associated with the failure of the uterus to decrease steadily in size there are apt to be an increase in and a prolongation of the bloody lochia, a coated tongue, and constipation. It is thus not a difficult matter to make an early diagnosis of subinvolution; and an early recognition of the condition is of the greatest practical importance.

The diagnosis of subinvolution in its later stage is, unfortunately, too often left to the gynecologist. At this time the uterus is larger than normal and is frequently displaced, usually backward, the os is more patulous than it should be, and the cervix very probably is lacerated. The walls of the uterus are considerably thickened, its vessels and lymphatics are enlarged, and its endometrium has undergone interstitial and glandular hypertrophy. If involution is permanently arrested, connective-tissue development in the muscle-

walls soon follows, the changes in the mucous membrane are permanent, and chronic metritis and endometritis are established, to be followed perhaps by periuterine inflammatory disease.

Treatment.—From the foregoing enumeration of the most important causes of subinvolution it is apparent that the proper treatment of each patient will be governed by the cause or causes that may be present retarding normal involution. While the patient is in bed the cause will usually arise from retention within the womb of deciduæ or placental masses and blood-clots, or of shreds of the membranes which may or may not be undergoing putrefactive change, but which are always a source of danger and usually require removal. The blood-clots accumulated within the womb can often be removed by stimulating the uterus to contract by gently rubbing the fundus of the uterus several times each day through the abdominal wall, followed by snug application of the pad and binder. When this maneuvre is not followed by prompt reduction in the size of the womb and by diminution of the loss of blood, the cavity of the uterus must be explored with the finger; then, if required, the curette and placental forceps should be used, followed by irrigation with creolin or bichlorid solutions and with boiled water, and the introduction of a strip of sterilized iodoform gauze, which should be removed and may be replaced at the end of forty-eight hours. When putrefactive change has begun to take place, which is announced by fetid discharge, rapid pulse, and fever, the necessity for curettage is absolute. Even when fetid discharge is absent the pulse and temperature may be such as to require currettage. The temperature chart (Fig. 141) illustrates the advantage of removing hypertrophied decidua. In

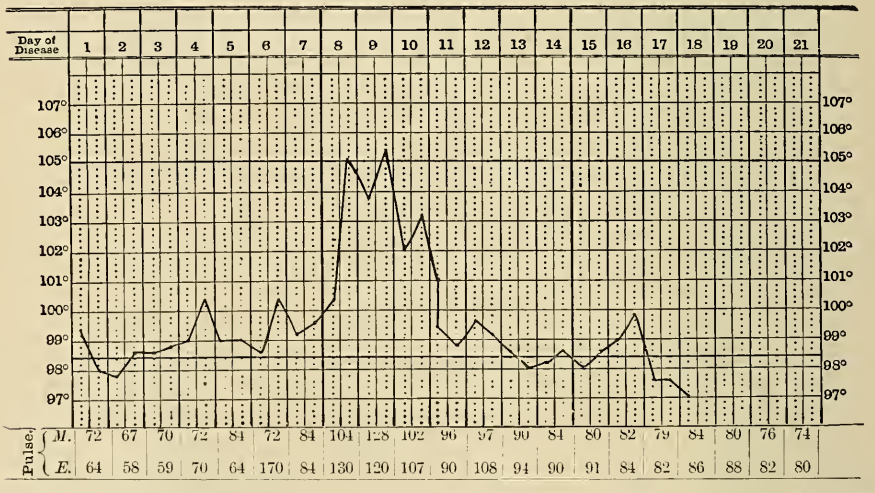


FIG. 141.—Hypertrophied decidua removed with curette and placental forceps on the ninth day; lochia not offensive.

this case the odor of the discharges was not offensive. In the absence of signs of decomposition the dangers of removing foreign material from the interior of the womb are in direct proportion to the obstetrician's ignorance of antiseptic

details. It should be remembered that curettage employed against puerperal infection accomplishes the most good when it is resorted to early, and especially after abortion. When infection has spread from the decomposing débris to the uterine wall the operation is less effective, and sometimes does harm by destroying the barrier of exudate which nature supplies to limit septic absorption.

If the womb is displaced, it should be replaced, and attempts should be made to keep it in position by the application of a lateral compress if the displacement is lateral, which is not very rare; by the Sims or the prone position for several hours each day if the displacement is backward; and in all cases by regular evacuation of the bladder and bowel.

When the above treatment has been instituted, or even when there has been no occasion for it, the duty of the obstetrician is always to make a vaginal examination before ceasing his attendance, noting the size and position of the uterus, the condition of the adnexæ, and determining the nature and degree of injuries of the cervix and vagina. If he now finds the uterus displaced, a properly fitted pessary should be applied and carefully watched, smaller sizes being substituted as the involution of the genitalia advances. At the same time it is desirable to deplete the pelvic viscera by copious hot injections, by glycerin tampons, and by free catharsis. Septic processes in or about the uterus should receive appropriate treatment. Advice may be needed as to the subsequent necessity for reparative operation. The rarer causes of subinvolution—cardiac or hepatic diseases producing venous stasis in the pelvic organs—should not be overlooked. The value of the regular administration of ergot as a means for promoting more rapid involution of the uterus is doubtful. The writer has reserved the use of ergot for those rare cases which seem to be dependent upon either a general lack of muscle-tonus or upon the presence of small and multiple fibroids, in which cases a pill composed of ergotin (gr. j), quinin (gr. ij), and strychnia (gr. $\frac{1}{20}$), administered thrice daily in conjunction with the application of the faradic current, has seemed beneficial. Should, however, the use of ergot impair to any extent the digestion or the milk-secreting functions of the individual, it is best to discontinue its use. Depletion of the pelvic viscera by the employment of copious hot injections, of glycerin tampons, and of free catharsis is also useful in this class of cases. Fibroid and polypoid tumors should be treated as directed in the discussion of *Puerperal Hemorrhages* (p. 268).

When the treatment of subinvolution is first instituted, several weeks after the patient has left her bed, and if she complains of frequent bleeding, leucorrheal discharges, dragging sensations, a feeling of weight and distress in the back and loins, and, finally, is overtaken by the digestive, circulatory, and reflex nervous disturbances of subacute and chronic inflammatory changes in and about the uterus, the case demands most careful gynecological examination and treatment, involving the repair, perhaps, of a lacerated cervix and perineum, the correction of a backward displacement, or treatment directed to the endometrium or to the periuterine structures.

4. Hemorrhages in the Puerperium.

Excessive bleeding from the uterus within twenty-four hours after delivery is called "post-partum" hemorrhage. Its causes and treatment have been discussed under *Dystocia* (p. 128). Hemorrhage occurring later than twenty-four hours after delivery is called "puerperal" or "secondary" hemorrhage. The quantity of blood lost during the first eight days of the puerperium has been stated (p. 167) to be three and a quarter pounds. Any excess of this amount should be looked upon as abnormal. The bleeding may vary from a slightly excessive discharge, which is the more common, to a sudden and alarming hemorrhage, which can as quickly be fatal or alarming in its after-effects as the hemorrhage that sometimes occurs immediately after labor. The bloody lochia continuing furnishes a favorable soil for the development and multiplication of micro-organisms, and thus is an additional risk to the puerpera.

When it is noted that the bloody lochia are excessive and prolonged beyond the third day, or when, having ceased at the usual time, there is a return,* investigation should be instituted at once to determine the cause, since the proper treatment of the case usually depends altogether upon accurate determination of the cause. A careful inquiry will necessitate an examination of the uterus, its contents, its position, and of the adjacent structures.

The causes of puerperal secondary hemorrhage, arranged as nearly as may be in the order of their frequency, are:

1. Retained secundines and blood-clots;
2. Displacement of the uterus;
3. Displacement of thrombi in the uterine sinuses;
4. Relaxation of the uterus;
5. Fibroid or polypoid tumors;
6. Hematomata;
7. Pelvic engorgement;
8. Secondary bleeding;
9. Malignant disease.

In a series of 3000 deliveries seven cases of severe puerperal hemorrhage were observed. The cause in two cases was over-distention of the bladder, producing uterine displacement; in one, retained portions of placenta; in two, the kidney of pregnancy; and in two cases no cause could be found.

Retained Secundines.—The most frequent cause of hemorrhage in the puerperium is retention of a portion of the secundines, commonly fragments of placenta, more rarely portions of the membranes. Cases of profuse bleeding from retained secundines are far more frequently observed after abortion or miscarriage than after labor at term. The writer recently removed a piece of healthy placenta from an almost moribund patient who, after a miscarriage, had been bleeding continuously and profusely throughout a period of sixteen weeks. The frequency of retained portions of placenta causing hemorrhage after deliv-

* A return of the bloody lochia for a day or two when the patient first rises from her bed is of common occurrence and of no pathological significance.

ery at term, compared with retention not followed by excessive bleeding, indicates that not infrequently nature successfully disposes of the remnant, in the absence of infection, by disintegration and drainage. Martin[61] reports nine cases of retained portions of placenta in 2960 births; in six of the nine cases there was not even an excess of the lochia, and in but two was the hemorrhage severe. The frequency of retained membranes is much greater, analysis of various statistics giving a proportion of about 5 per cent. But the frequency and probability of hemorrhage produced thereby are by no means so certain, clinical testimony on this point being at variance. It is reasonable to believe that retention of considerable portions of the membranes favors the accumulation in the uterus of blood-clots which may be of sufficient size to prevent firm contraction, and thus indirectly the retained membranes may be responsible for bleeding, which, however, is seldom profuse enough to endanger life.

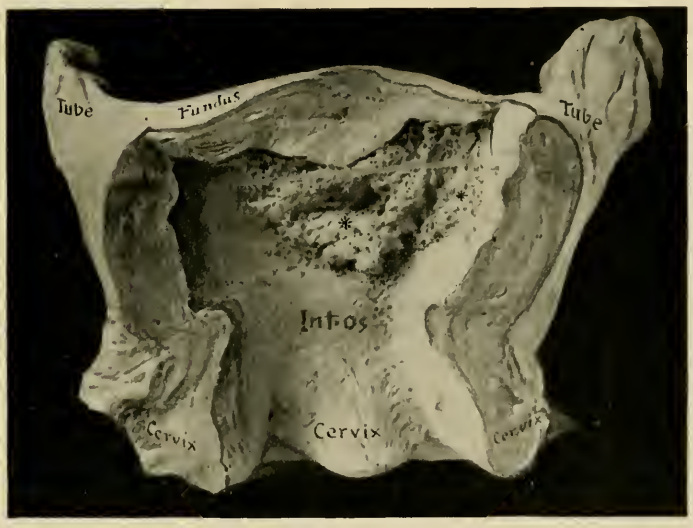


FIG. 142.—Retained hypertrophied deciduæ (New York Hospital Cabinet).

When considerable portions of the decidua are retained, whether hypertrophied during pregnancy or after labor, and when to these are added, as is very common, clot-formations of fibrin and blood, an excessive and prolonged lochial discharge is almost certain to result (Fig. 142). Syphilitic endometritis, occurring either during pregnancy or after labor, is a frequent cause of hypertrophied decidua.[62]

Should a large blood-clot be retained in the uterus, the bloody flow may almost cease, and be replaced by a watery discharge; within a few days there may be a sudden discharge of disintegrated, followed by bright, blood in such large quantity as to cause the patient's death within an hour. A case of this kind has been reported by Parvin.

The so-called "placental and decidual polypoid tumors," having their origin in the puerperium and causing hemorrhage, are really layers of clotted blood or fibrin deposited upon fragments of the secundines or upon a rough-

ened placental site. These fibrin-formations[63] may in very rare cases become malignant, as will be pointed out later. Rémy[64] has recorded an interesting case of inversion of the uterus in the third week due to the efforts of the uterus to expel retained fragments of the placenta.

Diagnosis and Treatment.—Careful management of the third stage of labor always includes an inspection of the placenta and of the membranes, to determine whether any portions of either have been retained in the uterus. When there has been an accessory placental growth—either succenturiata, which has blood-vessel communications with the main placental growth and is therefore functionally active, or spuria, which has no such connection—the diagnosis is, of course, very difficult, and in the latter case is practically impossible. The succenturiate placenta can be diagnosticated by examining the membranes with transmitted light, and observing large vessels passing from the circumference of the main placenta through the membranes and terminating in torn extremities where they have been detached from the accessory growth.

So commonly is puerperal hemorrhage due to retained secundines that it is usually justifiable at once to explore the uterine cavity when the bleeding is profuse; vaginal and abdominal examination will disclose a failure in the normal diminution in size of the uterine body. If the cervix is retracted, which is unusual when the uterus contains material that should have been thrown off, Hegar's or branched dilators may be employed to open it sufficiently for the introduction of the finger, and by bimanual examination the interior of the uterus should be explored. Fragments of retained secundines may thus be removed, followed by thorough curettage, removal of dislodged particles by placental forceps, and an intra-uterine douche of sublimate solution (1 : 4000), followed by boiled water, or of creolin (2 per cent. solution). When treatment is undertaken after involution has advanced, and the size of the uterus renders the introduction of the finger difficult, the curette and forceps cautiously but thoroughly used will suffice.

Uterine Displacements.—The puerperal uterus may become displaced backward, forward, upward, downward, laterally, or more rarely it may be inverted. From a clinical standpoint it is desirable to consider abnormalities in the position of the uterus according as the symptoms occur *early* or *late* in the puerperium.

The normal position of the uterus immediately after labor is marked anteversion with prolapse, especially of its lower segment. During the first twenty-four hours its retraction elevates the body of the womb to its natural position of anteversion, and the fundus, from the large size of the organ, moves freely about from side to side, rendering a displacement likely of occurrence if the woman is kept lying in one position, or when the bowel or the bladder is permitted to become over-distended, or when a compress and binder have improperly been applied. The result of such displacement is occlusion of the uterine canal by angulation-stenosis, with consequent retention of the lochial discharge and the accumulation of blood-clots, which, if they do not undergo putrefactive changes and expose the patient to the dangers of infection, lead to

subinvolution of the womb by mechanically preventing contraction and promoting a passive congestion of the organ. The lochial flow, which at first may have been diminished and very watery, finally, after a few days, reappears, at first very dark, then bright red, and usually profuse, and in rare instances there may be alarming hemorrhage.

The angulation produced by a *flexion* of the womb either forward, backward, or lateral while the patient is yet in bed diminishes the lochial flow until it may almost wholly cease, the blood being retained in the uterine cavity. Very commonly under these circumstances there occur putrefactive changes accompanied by elevated temperature, rapid pulse, and other signs of putrid absorption. Such cases are repeatedly observed, and when, as should always be done, an intra-uterine douche is given, the first introduction of the syringe-nozzle corrects the angulation, and is at once followed by a sudden gush of offensive fluid containing shreds of necrotic decidua and blood-clots. The displacement interferes also with involution, as previously stated, and favors the retention and hypertrophy of decidua; hence the irrigation should always be followed by curettage. Cases which escape infection, but ultimately lead to engorgement of the pelvic and uterine vessels, are followed by bleeding more or less profuse. Usually the flow is moderate but persistent, and after a time the patient is reduced in strength. Occasionally a sudden and alarming loss of blood will occur. In addition to exploration of the uterine cavity, the condition of the bowel and the bladder should receive attention, and by the careful adjustment of a properly-placed pad and binder the displacement can often be corrected. The displacement caused by an overdistended bladder is almost invariably upward and to the right. The nurse should receive minute instructions as to the manner of adjusting the pad, and when the displacement is lateral she should be taught to press the uterus toward the median line and to reapply the pad several times each day.

Inversion of the puerperal uterus usually occurs immediately or soon after labor, but it may occur during the puerperium, even so late as the third week, as happened in the case reported by Rémy.[65]

The *cause* of this rare accident may be severe straining at stool, or efforts of the womb to expel a foreign body, such as a polypoid tumor or a large piece of placenta. The *diagnosis* and *treatment* of inversion of the uterus have been discussed (pp. 148, 150). It remains only to be stated here that when this accident first occurs several days after delivery, it should be borne in mind that the inverted uterus is especially likely to be mistaken for a polypoid tumor, from which it is readily diagnosticated by bimanual and rectal examination and by an attempt to pass a uterine sound. Other conditions to be remembered, which under some circumstances simulate an inverted uterus, are hematoma of the vulva, of the vagina, or of the cervix, prolapse of the uterus, and possibly vaginal enterocele.

Displacement of the uterus at a later period of the puerperium is usually *retroflexion* or retroversion (Pl. 43), with varying degrees of prolapse.

The *cause* of the displacement is almost invariably subinvolution, not only

of the uterus, but also of its ligaments and of the vagina. The injury of the vagina which contributes to the displacement is a neglected laceration of the pelvic fascia and the levatores ani muscles. In very rare cases, when these injuries have been very severe and the entire attachment of the vagina has been severed, premature getting up and prolonged straining at stool or the lifting of heavy weights have caused complete *prolapse* of the puerperal uterus. The *treatment* of such displacements belongs to gynecology and comprises curetting and packing the uterus with gauze, followed by plastic operations on the vagina, or one of the operations devised for suspending or fixing the uterus in its normal position.

Separation or Disintegration of Thrombi in the Sinuses at the Placental Site.—Alarming hemorrhage may follow either of these accidents even so late as two or three weeks after delivery. Separation may occur when the patient is permitted to assume an upright posture or is allowed to get out of bed soon after labor. After the third day this danger would appear very slight, since in several thousand cases at the Preston Retreat, Philadelphia, where it has been customary for the nurse to help the patient to the commode rolled to the bedside, no such accident has been recorded.

Disintegration of clots leading to dangerous hemorrhage sometimes accompanies puerperal infection which has produced necrotic changes in the thrombi. Hemorrhage may occur spontaneously in these cases, and it has been observed in the course of treatment when the cavity of the womb is curetted. When alarming bleeding occurs soon after delivery and the uterus is found empty, dislodgement of thrombi should be suspected, and the bleeding should be controlled by an intra-uterine tampon of iodoform gauze. The same treatment is applicable to hemorrhage from disintegration of thrombi.

Relaxation of the Uterus.—Hemorrhage from this cause, and of severe type, may rarely occur within the first three days after labor. It may be a sudden outpouring of blood, or, the cervix being obstructed by a clot, the blood may accumulate in the uterus, in which case the patient's condition of faintness and the pain caused by the over-distention of the uterus may be the only signs of the accident until the size of the uterus is ascertained by palpation. Bleeding so sudden and alarming as this is invariably due to relaxation of the uterus. This accident, which is of rare occurrence, is usually found in women of lowered vitality and muscular weakness. One case of the writer's, occurring forty-eight hours after labor, was doubtless due to the exhaustion and relaxation following vigorous purgation and the free use of chloral and veratrum in the treatment of violent eclamptic attacks during labor. In two other cases the hemorrhage occurred ten and twelve hours respectively after the delivery of twins. Sudden and profound emotion has been followed by profuse hemorrhage, probably the result of relaxation, although alteration in blood-pressure has been claimed to produce it. Hemorrhage due to relaxation of the womb should be treated promptly by emptying the womb by expression or by the introduction of the hand, followed by the usual means of controlling bleeding

immediately after labor, resorting, if need be, to the employment of an intra-uterine iodoform-gauze tampon.

Fibroids.—The dangers of uterine fibroid tumors complicating the puerperium are twofold. The greater danger is the possibility of the tumor undergoing necrotic change and septic absorption from the sudden diminution of its blood-supply during the processes of involution of the uterus. The lesser danger, yet one of great importance, is the hemorrhage it may occasion, rarely profuse, but usually sufficiently prolonged to impair seriously the patient's strength and health. Hemorrhage is very prone to occur when the tumor is submucous or pedunculated. Interstitial and subperitoneal tumors may not be productive of hemorrhage, but they may undergo the sloughing change just referred to, and, besides, may so thin the uterine wall as to add the risk of perforation when the uterine cavity is being explored by the curette or other instrument.

The diagnosis of fibroid tumors in the puerperal uterus can be made by intra-uterine and bimanual examination. If, when a tumor is discovered, hemorrhage is the only complication present, it may be controlled temporarily, if not profuse, by the daily use of ergot, strychnia, hydrastis, and the faradic current. Should the tumor be polypoid, it is best to remove it by the wire écraseur and scissors. If sloughing has occurred, which is announced by a foul discharge, this treatment, or removal of the tumor by the blunt curette, care being taken not to perforate the uterine wall, or hysterectomy, is imperative. Should interstitial or subperitoneal tumors become necrotic and threaten sepsis, hysterectomy is indicated.

Hematoma.—Hematoma in the puerperium has been discussed on page 195.

Pelvic Congestion.—Pelvic congestion from any cause may occasion hemorrhage of varying severity in the puerperium. The increased blood-supply to the pelvic organs and the return for a few days of the bloody lochia when the puerperal woman first rises from her bed constitute a frequent and physiological example of the occurrence of pelvic congestion. When the bleeding is prolonged beyond a few days, a pathological condition should be looked for in subinvolution with uterine displacement, in periuterine inflammation, or in a too early resumption of, or desire for, sexual intercourse. Occasionally other causes may be discovered, such as an accumulation of fecal masses in the rectum, an intrapelvic tumor, or disease of the liver, kidneys, or heart.

Secondary Bleeding.—Rare cases have been recorded of rupture of an artery or a vein by erosion, and of hematomata and secondary hemorrhage following lacerations, in which cases the bleeding was controlled temporarily by the pressure of the child's head during labor. In such cases the bleeding vessel should, if possible, be found and ligated; otherwise a firm antiseptic tampon is the only recourse.

Hemorrhage from malignant disease is of rare occurrence, since malignant diseases of the uterus, either carcinoma or sarcoma, usually prevent conception. Digital examination will at once make the diagnosis of malignant

disease of the cervix, and the hemorrhage may be controlled by a vaginal tampon frequently renewed until the advisability of hysterectomy has been considered.

Cancer within the body of the womb complicating the puerperium is also rare. Whether in most cases the disease exists prior to impregnation, as insisted upon by Veit, or whether it develops after labor, either at the placental site or in the decidua, is not by any means certain. In either case death ensues within a few weeks or months. Müller[66] found, in an analysis of 577 cases of carcinoma of the uterus treated in Gusserow's clinic, that in 8.14 per cent. the disease developed during pregnancy or the puerperium. Cases of malignant disease developed at the placental site have been reported by Chiari,[67] Kucher,[68] and others. Gaylord* collected 55 cases of cancer of the placental site. Von Kahlden[69] described a case of malignant degeneration of a placental polyp in which case death occurred eleven weeks after delivery.

The two forms of malignant disease that have been thoroughly studied in recent years are: (*a*) Syncytial cancer originating from the syncytial cells of the chorionic villi; and (*b*) malignant deciduoma (deciduosarcoma), a sarcomatous degeneration of the decidua. The former is more frequent than the latter, and both are characterized by early and wide-spread metastases.

Gottschalk[70] reviews 10 cases of malignant deciduoma, of which eight had previously been reported, and he records a case (a VI-para æt. forty-two) in which, the recurring hemorrhages not being relieved by repeated curettage, he dilated the cervix and examined microscopically the scrapings from the placental site. Sarcomatous new growths of the fimbriæ of the placenta were found. Although the patient's general condition was bad and her temperature was 104½° F., the uterus and ovaries were removed eight weeks after delivery, and recovery followed. Bacon[71] described in detail a case of deciduoma malignum, and gives a table of all the cases reported, fifteen in number, of tumors composed of elements derived from decidual cells, and five cases of tumors composed of elements derived from chorionic villi. He points out the important clinical fact that half of the cases followed molar pregnancy, and in support of the notion that the tumors began during pregnancy he states that in twelve out of 18 cases the hemorrhage was known to have appeared almost immediately after labor or abortion. As to prognosis, he says, "All cases have terminated fatally except two which have been reported this year. In one of these cases, that of Nové-Josserand, the uterus has been removed. In three previous cases this operation was done in vain. The other non-fatal case was Menge's patient, who received a simple curettement of the uterus. The further report of this case will be of special interest."

When continued hemorrhages are not relieved by the curette and are not traceable to constitutional disturbances or to other evident local causes, the possibility of malignant disease should be thought of, and the scrapings should be subjected to critical microscopical analysis. The result of malignant disease of the puerperal uterus in the reported cases has, with one exception, been a

* *Trans. Section on Gynecol., College of Physicians*, Phila., 1898.

rapidly fatal termination, except when the uterus was wholly removed. This fact points to extirpation as being the only rational treatment when a positive diagnosis of malignancy has been made sufficiently early. Should the hemorrhage meanwhile be profuse and alarming, the intra-uterine gauze-tampon may be employed.

Among other conditions very rarely causing puerperal hemorrhage should be included profound emotion, syphilis, chlorosis, scurvy, nephritis, and malaria. Hemorrhage due to either of the blood-dyscrasiæ is probably the result of changes in the blood preventing the formation of obliterating coagula (Cazeaux).

There is yet some difference of opinion as to malaria being a factor in puerperal bleeding. Billon in his inaugural thesis (Paris, 1883) denies any such influence after carefully analyzing 90 cases. Liègeois, however,[72] describes such a case, and the writer recently observed a case of free bleeding apparently due to this cause. It has been pointed out by Winckel[73] that free bleeding often follows the determination of blood to the internal organs by a chill, which fact may explain the hemorrhage observed in some cases of malaria.

5. Anomalies of the Nipples and the Breasts.

The anomalies of the nipples are of clinical importance by reason of their relation to inflammation of the breast during lactation. In ninety-seven cases of puerperal mastitis Birket[74] found imperfect development of the nipples in forty-eight.

Athelia, or absence of the nipple, is sometimes congenital; it may be the result of traumatism or of suppuration of the breast in the new-born infant.

Microthelia is the name given to small, ill-developed, or sunken nipples. Microthelia is by no means uncommon; it may be the result of a congenital defect, or the condition may be acquired from the wearing of faulty clothing or of corsets compressing the breasts and flattening or even invaginating the nipples. The accompanying illustration (Fig. 143) shows diagrammatically several varieties of badly-shaped and ill-developed nipples which interfere with suckling. The sunken or invaginated nipple cannot readily be grasped by the infant's mouth, and the insufficient flow of milk aggravates the child and leads to vigorous biting and tugging, which are soon followed by erosion or fissures of the nipple. When the infant takes the mushroom-shaped nipple into its mouth the narrow base of the attachment of the nipple to the breast is further occluded and thus a free flow of milk is prevented, and traumatism of the nipple follows the increased efforts of the child. The treatment of microthelia will be referred to later.

Polythelia.—In polythelia—supernumerary nipples—the multiple nipples are usually found in a line running downward and inward or upward and outward, analogous to the situation of the nipples in the lower animals. Bruce[75] found supernumerary nipples relatively frequent among women—4.8 per cent. in 104 women.

Amazia, or congenital absence of one or of both breasts, is an extremely rare anomaly. According to Delbert, the absence of one breast has been observed only in women, and the absence of both breasts occurs only in monsters having usually other deformities incompatible with life.

Micromazia, or small breast, which is a defect very much more frequent than amazia, is sometimes associated with an infantile uterus.

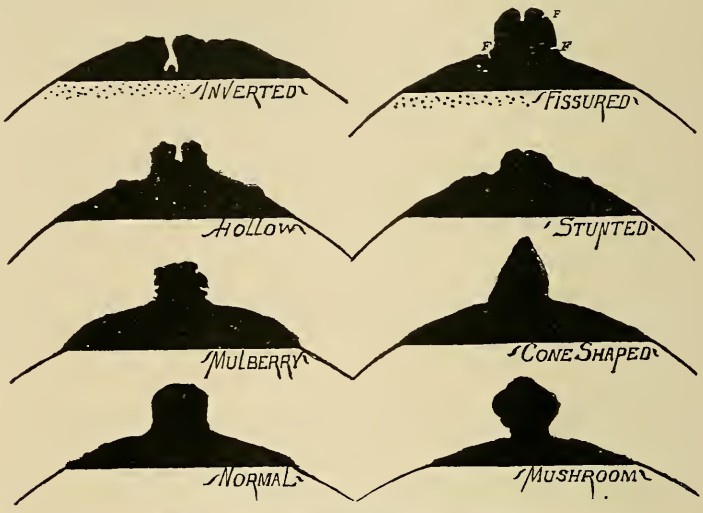


FIG. 143.—Faulty development of the nipple.

Polymazia, or supernumerary mammary glands, is an anomaly more frequent than amazia. The multiple breasts may vary from a small nodule of glandular tissue to a fully-developed breast capable of nourishing an infant. Although sometimes situated in the axilla, on the back, or on the thigh, the glands are commonly seated upon the anterior wall of the chest.

6. Disease of the Nipples.

Sore Nipples.—Under the term "sore nipples" is usually described a group of inflammatory conditions of the nipple varying in severity from a simple yet painful erythema to erosions, ulcers, and fissures that may occasion so great distress as absolutely to contra-indicate nursing. Clinically, sore nipples are of the greatest importance on account of their close relation to mastitis and mammary abscess. When the irritation of the nipple passes beyond simple erythema, the epithelium is denuded at one or more points, leaving the underlying papillæ unprotected. Within a few hours there is likely to appear an erosion (Pl. 47) situated most often upon the apex of the nipple, next in frequency upon the sides, and least frequently at the base of the nipple. If at this time proper curative treatment is neglected, the erosions are often converted into fissures.

When the natural divisions between the papillæ at the summit of the nipple are deeper, broader, and larger than normal, the removal of the overlying

DISEASES OF THE NIPPLE: Erosion of the nipple (from a photograph).

epithelium by the lips and tongue of the child in the act of sucking leaves deep fissures which are very troublesome, cause intense pain, and often bleed at each nursing. Fissures situated at the base of the nipple, at the junction of the nipple and the areola, are usually semilunar in shape; they are often the most difficult to heal, because the act of sucking almost always separates their edges, and thus at each repeated nursing they grow deeper and extend more and more around the nipple, sometimes even penetrating a milk-duct and leaving a milk-fistula. Rarely the nipple is thus partially, or even wholly, amputated.

The frequency of fissures of the nipple is estimated by Kehrer as 44 per cent. in primiparæ, in whom sore nipples are certainly more frequent than in multiparæ. Hübner states that 51 per cent. of nursing mothers between the third and the fifth day will have fissured nipples. Winckel found seventy-two among 150 nurses. Dluski[76] found one hundred and eighty-one cases, ninety-nine being slight, in 433 recently-confined women in Baudelocque's clinic. Women with delicate skin, particularly blondes, are more liable to have sore nipples. The frequency, certainly of severe cases, is doubtless in some measure dependent upon the degree of cleanliness and care of the nipples in the early days of lactation.

Etiology.—The anatomical structure of the nipple, particularly when there are developmental defects, predisposes the organ to inflammation, on account of the injury it is likely to receive during the act of sucking. The delicate epithelial covering of the nipple, being softened and macerated in the child's mouth, is then readily removed at various points, leaving the papillæ unprotected and bathed with milk and often with blood, both of which are excellent media for the growth and development of micro-organisms. When the nipples are misshapen, short, or inverted (Fig. 143), the infant is unable readily to grasp the nipple with its mouth, and efforts at sucking are consequently more violent and the traumatisms to the nipple are thereby correspondingly increased. While some authors consider the traumatism of sucking the most important element in the etiology of sore nipples, others lay most stress upon bacterial invasion from the nurse's or the mother's fingers, from soiled cloths, and often from the child's mouth. The truth doubtless lies, as is so often the case, in the middle ground. The trauma lessens the resistance of the nipple-structures to invasion by micro-organisms, and when scrupulous cleanliness of both the nipple and the infant's mouth is neglected a slight irritation becomes an infected wound. Bumm[77] frequently found in fissured nipples bacilli and cocci, and even the staphylococcus aureus and albus, when there was no adjacent inflammation.

Symptoms.—From the third to the fifth day of the puerperium the ulceration at some point of the nipple usually appears, accompanied by very severe pain, and in nervous individuals easily responding to reflex irritation, or when the sore is infected, the temperature may rise as high as 104° F. or higher, and may even be accompanied by convulsive movements. The nervous irritation and the apprehension of the excruciating pain occasioned by nursing sometimes prevents sleep and seriously interferes with the appetite and digestion.

Treatment.—The prophylaxis should begin in the latter months of pregnancy. Pressure upon the nipples by corsets and by clothing must be avoided. The nipples should be washed morning and evening with a bland soap and water, followed by inunction with cacao-butter, lanolin, or sweet oil, and once each day they should be treated with a saturated solution of alum or with a 50 per cent. solution of glycerol of tannin. When the latter is used the patient's underclothing should be protected from being soiled by the tannin. If the nipple is invaginated, attempts may be made to draw it out with the fingers, or, what is more effective, by buccal suction or by the application over the nipple of the mouth of a bottle just emptied of hot water. These manipulations are to be employed only in the last months of pregnancy, since they can cause premature termination of pregnancy. Layers of adhesive plaster around the nipple, 4 centimeters (1½ inches) in width and 13 millimeters (½ inch) thick, may be worn some months before labor. When these measures fail, if the malformation and shortness of the nipple are not too great, and if it is especially urgent that the mother should nurse her child, the operation of mammillaplasty, first suggested by Kehrer, will improve the defect. Williams[78] thus describes the operation: "A circular strip of skin, together with the subjacent fibro-fatty tissue, is excised from the prominent cutaneous fold surrounding the depressed nipple; or, instead of a circular strip, two crescentic pieces may be removed (Kehrer). Care should be taken to avoid injuring the subjacent ducts; this will be rendered almost impossible by keeping the incisions external to the areola. On suturing together the opposite cut edges of the mammillary and mammary skin the nipple will be pulled into its proper position. In a case reported by Herman[79] the operation resulted in a permanent cure. Of course, not much good can be expected from this proceeding when the nipple is congenitally stunted and malformed."

From the earliest period of lactation close attention to cleanliness of the nipple and of the child's mouth is of the greatest importance. At least once a day, preferably oftener, the child's mouth should be washed with a saturated solution of boric acid or of borax. Before and after each nursing, which should be at regular intervals, the nipples are to be washed gently but thoroughly with absorbent cotton and the boric-acid solution and carefully dried. If the epithelium is at all inflamed, the nipples, after nursing, should be covered with a protective ointment. For this purpose either of the following ointments, spread upon a clean piece of lint or waxed paper, will be useful:

℞. Acidi borici, gr. xx;
Olei ricini,
Bismuthi subnitratis, āā ʒij.

Or,

℞. Tincturæ benzoini compositæ, gr. xv;
Olei olivæ, ʒij;
Lanolin, ʒvj.[80]

Or the nipple may be covered with lint wet with dilute lead-water—a plan

having the disadvantage of necessitating thorough washing from the nipple of every trace of the lead lotion before the child nurses. The distilled extract of witch-hazel diluted with three or four parts of water the writer has found especially useful, alternating this lotion with the bismuth paste.

When the epithelium is eroded at several points or in one large area, following the same precautionary cleansing before and after nursing, the ointments above referred to, or either of the following, may be used: Iodoform, gr. x; oxide-of-zinc ointment, ʒss; or, Ichthyol, ʒj; lanolin and glycerin, āā ʒiss; olive oil, ʒiiss. The compound tincture of benzoin, or a 10-grain solution of silver nitrate, painted on with a brush, will sometimes be useful. Powdered tannic acid dusted over the raw surface, and kept in place by a small circular piece of lint smeared with cosmolin, is highly praised by Garrigues.[81]

For a distinct and deep fissure, whether situated at the apex or the base of the nipple, the solid stick of nitrate of silver, applied carefully and only to the

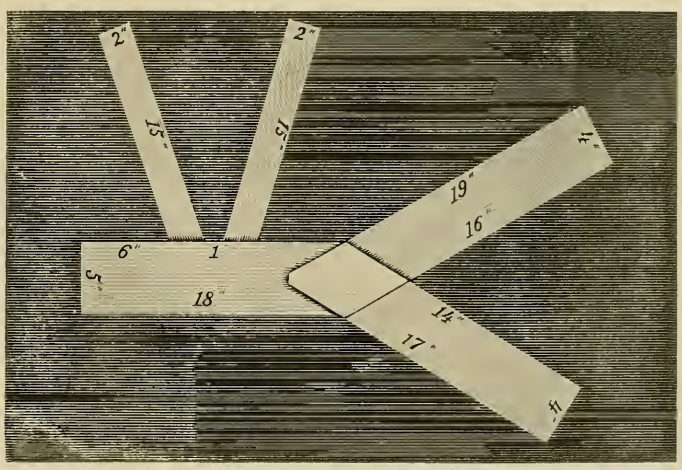


FIG. 144.—The Y-bandage (Boston Lying-in Hospital).

fissure, is perhaps the most efficient treatment. This application may often with advantage be followed a day later by careful coaptation of the surfaces of the fissure by pressure with the fingers, the coaptation being thus maintained until the fissure is permanently held together by a few drops of collodion and a thin film of absorbent cotton.

While one or more of these local applications are being carried out it is always desirable to resort to a mammary binder (see Fig. 147, p. 279) and to relieve somewhat the mother's pain and prevent further injury to the nipple by using a nipple-shield. Of the numerous varieties of shields, that figured in the illustration (Fig. 145)—a glass bell with a soft-rubber nipple—is most useful. The shield should always be taken apart after nursing, be cleansed thoroughly, and be kept immersed in a tumbler containing boric-acid solution. It is desirable also occasionally to wash the shield in a 5 per cent. carbolic solution or to boil the glass bell for twenty minutes. Persistence on the part of both nurse and mother will often overcome the child's aversion to a shield, particularly if the

glass bell of the shield is tightly applied to the areola and partially filled with milk by stroking the breast before the rubber nipple is placed in the child's mouth. If the shield can be used, much has been gained toward the prevention of more serious trouble in the breasts by thus avoiding congestion and engorgement of the glands—an accident not unlikely to occur if the extreme pain of suckling makes it necessary to give up nursing, and if at the same time the nurse is not skilled in preventing mammary engorgement by massage (Pl. 48), a measure, when the manipulations are skilfully performed, vastly superior to the breast-pump. The nipple-shield, however, should not be used in case the fissure is so situated that the action of the shield is observed to aggravate the condition by pulling open the fissure, thus failing to relieve the mother's pain each time the child sucks. Fissures located at the base of the nipple will sometimes be aggravated by the shield. The shield should be given up at the earliest possible moment after the nipple has healed.

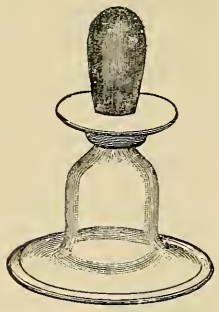


FIG. 145.—Nipple-shield.

Sometimes it will be necessary for a few days to remove the child wholly from the nursing breast. Usually twenty-four hours will be sufficient to allow the fissures to heal under appropriate treatment, but in severe cases, when mammary inflammation is threatened, three or four days may be required. Meanwhile massage and other means to prevent mastitis are to be employed. In very exceptional cases nothing short of artificial feeding and drying up of the breasts will give permanent relief—a defeat not to be permitted except in the presence of an imminent mammary abscess or when the epithelium of the patient's mammary glands and the nipples have proved, on the one hand, unequal to a sufficient supply of milk, and, on the other hand, incapable of tolerating the more active biting and tugging of the infant at the nipple, which efforts continue to destroy the epithelial covering of the nipple.

Abscess of the Nipple.—There has been described[82] a deep inflammation of the nipples that undergoes resolution or, more often, results in the formation of a small abscess either in the lactiferous ducts or in the connective tissue of the nipple. This affection is a very rare one. If pus forms in the ducts, it is evacuated spontaneously through the apertures of the ducts; if the abscess is confined to the connective tissue, the nipple enlarges, and becomes very red and tender, which changes are often soon followed by a spontaneous opening; when the opening is delayed an incision should be made on the circumference of the nipple, after which there is rapid healing. Lactation should be interrupted for a few days until there is no longer a trace of pus.

Eczema.—Eczematous affections of the nipple and the areola sometimes spread to the adjacent integument of the breast; these affections are often difficult to cure, weaning being necessary in some stubborn cases. Stumpf,[83] who has thrown the light of bacteriology upon the clinical fact that eczema of the nipple sometimes leads to mammary abscess, demonstrated the presence in eczema of the breast and nipple of a staphylococcus, probably pyogenes aureus;

he found the same micro-organism in the milk of those affected, and he believes that the reinfection thus occurring explains the stubborn character of the disease.

Treatment.—Protective ointments containing zinc, salicylic acid, or carbolic acid are useful in some cases; in other cases more active remedies, such as resorcin, nitrate of silver, or corrosive sublimate, should be employed, care being taken always to wash the nipple thoroughly before nursing.

The breast is sometimes affected with *scabies*, and occasionally with *herpes zoster*. *Syphilitic ulcers* should be recognized promptly, and should receive local and constitutional specific treatment. When the child presents no evidence of syphilis weaning is imperative.

7. Diseases of the Breasts.

Congestion and Engorgement of the Mammary Glands.—At the first appearance of the flow of milk, and thereafter throughout the lactation period, especially during the first two weeks, it is not uncommon suddenly to find the

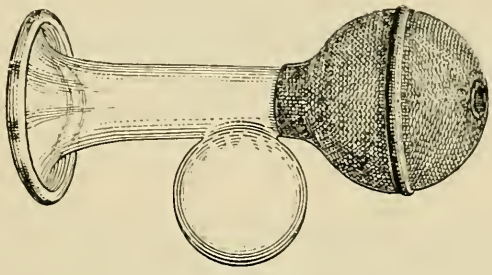


Fig. 146.—Breast-pump.

breasts engorged with milk, accompanied sometimes by pain and tenderness and a slight rise in temperature; or the reaction may be so slight as to occasion only distress and a sense of fulness of the mammary glands. Hypersecretion of milk and exposure to cold are commonly the causes of this condition, which is promptly relieved by removing the excessive amount of milk in the breast and by preventing further engorgement. The over-distention of the gland is relieved by more frequent application of the infant to the breast, by massage, or by the breast-pump. Of the various breast-pumps offered in the shops, that called the "English" (Fig. 146) is the most desirable and efficient. Further engorgement will be prevented by the administration of one or two full doses of a saline purge to obtain free catharsis, and by compression of the breasts with a mammary binder.

Support and Compression of the Breasts.—Various means have been devised for obtaining compression of the breasts. Strapping with strips of adhesive plaster, the roller bandage, painting the breasts with contractile collodion, and the various types of mammary binders are means each of which has its champions. As a matter of fact, with the exception of adhesive plaster, with which it is not easy to obtain persistent uniform compression, and which is trouble-

some on account of the painful excoriations of the skin produced, each of these means is specially useful under certain circumstances, and each, therefore, has its special indications. It is the writer's custom in both hospital and private practice to apply a mammary binder to every puerperal patient when the milk-flow is beginning to be established. At this time support, not compression, of the breasts is desired. For this purpose the Murphy binder (see Fig. 121, and description, page 174) is ordinarily used, because of its simplicity, efficiency, and ready manufacture. When, however, the nipples are stunted or otherwise ill-developed, the Murphy binder has the disadvantage of aggravating the defect by firmly compressing the nipple against the breast, and by increasing the heat and moisture of the nipples, both of which effects render sore nipples more liable of occurrence. To escape these disadvantages the writer has some of these bandages made with an opening about the size of a silver half-dollar over each nipple (Fig. 147). The margins of the openings are button-hole stitched. This modified bandage is used when the nipples are stunted or are inverted or when it is necessary to make applications to eroded nipples—such, for example, as the bismuth paste or the witch-hazel lotion. The nipple, after being cleansed, is smeared with the paste, and a disk of clean waxed paper with a film of the paste at its centre is placed over the nipple, after which the bandage is applied. The infant may now be nursed, or repeated applications of a lotion may be made, without loosening the bandage. Should the nipple and the areola show any evidences of edema, which will sometimes happen when the bandage is too tightly applied, the swelling will be relieved by loosening the bandage and, if necessary, by pinning over each opening a strip of muslin only slightly compressing the nipple.

When it is desired to compress the breasts firmly, as in threatened mastitis and after massage, a straight strip of unbleached muslin tightly encircling the chest over the breasts, or the Y-bandage (Boston Lying-in Hospital), is preferred (Fig. 144). The latter is applied as indicated in Figure 148. After dusting the surface of the breast with powdered starch or other bland dusting-powder, the base of the Y is drawn beneath the patient's back until the apex of the fork is external to the outer edge of the breast. The patient now lifts upward and toward each other the two breasts, and the lower arm of the fork is snugly drawn across the chest beneath the breasts, the inferior border of this arm extending at least an inch below the margin of the glandular tissue. The free end of the arm is now pinned to the free end of the strip that has passed beneath the back, and the inferior border is prevented from slipping upward by two safety-pins attaching it to the abdominal binder. The upper arm of the fork is then drawn across the chest above the breasts, the upper border of this arm extending an inch beyond the glandular tissue of the breast, and the free end of the arm is pinned to the end of the strip passing behind the back. The upper border of this arm is prevented from slipping by pinning it to the shoulder-straps. To secure smoothness of the bandage and uniform pressure of the breasts, safety-pins are now applied where the two arms of the bandage join each other under the axillæ; the

FIG. 147.—Modified Murphy breast-binder.

FIG. 148.—The Y-bandage (Boston Lying-in Hospital).

FIG. 149.—Roller bandage applied to both breasts.

FIG. 150.—Roller bandage applied to one breast.

pinning should be from the axilla toward the areola in order to decrease the pressure of the bandage gradually as the nipple is approached. A folded towel covered with a layer of absorbent cotton is now placed between the breasts to exert pressure upon their inner surfaces, and the two arms of the bandage are brought together and fastened between the breasts by means of a safety-pin. This bandage, when properly applied, should exert so much compression of the breasts that milk soon begins to flow from the nipple. The bandage will therefore occasion considerable pain, making it necessary to loosen it after a few hours. It should be worn for several days, with a degree of compression only short of producing pain. After all signs of inflammation have subsided the Murphy binder may be substituted.

Ordinarily the two bandages just described will serve the purpose of support or of compression of the breasts. When, however, it is desired permanently to discontinue lactation, and to dry up the breasts when abscess is threatened, the degree of compression needed is best obtained by a tight roller bandage (Figs. 149, 150) or, what is even more efficient, though very painful, by a dressing of contractile collodion. A circular piece of material sold in the shops under the name of "silk illusion" is applied to the breast, and should extend 2 or 3 inches beyond its periphery, with a central opening for the nipple and areola. To prevent puckering and to secure close adaptation to the contour of the breast, the material is cut at intervals of an inch or more from the periphery toward and halfway to the central opening. The breast is smoothly covered with the circular piece of illusion thus prepared, and a thin layer of collodion is applied and allowed to dry. Successive layers of collodion will give any amount of compression desired. Notwithstanding every precaution a circle of blisters around the periphery of the dressing is likely to occur. This disadvantage, and the possible necessity of releasing the breast temporarily for practising massage when compression fails to drain the breast, make the collodion dressing of doubtful utility. A very firmly applied Y-bandage or the roller bandage is almost as efficient and certainly is less troublesome and less painful.

Massage of the Breasts.—To achieve the best results from manipulation of the breasts it is necessary to know its limitations as well as its indications, and more important than all is an intimate knowledge of its technique. The physician should give the matter his personal attention when there is not at hand a nurse upon whom he can rely for its proper performance. The important contra-indication to breast-massage is interstitial inflammation of the breasts. It is a method of treatment of great value for the relief of pain and tension in the breasts, due to engorgement with milk when the infant fails to empty the breast properly, especially when the nipple is sore. Breast-massage is also useful in mastitis to empty the gland-acini of their contents, and even of pus in the early stage of parenchymatous abscess; thus it has often saved the anxiety, pain, and sequelæ of lancing such an abscess.

Technique of Breast-massage.—After cleansing the breast the entire skin-surface of the breast is anointed with a lubricant, preferably with camphorated

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Massage of the breast (from photographs).

or carbolized oil. It is the writer's practice either himself to perform or to teach his nurse *four* distinct manipulations. The first manipulation is one of gentle and quickly-repeated strokes of the finger-tips (Pl. 48, Fig. 1). The breast can conveniently be supported during the manipulation by the patient placing her forearm under the breast, drawing the breast upward, and supporting it. Starting at the periphery of the gland, the fingers are separated, and are brought together as the tips of the fingers terminate the stroke at the nipple. Each segment of the gland should thus be rapidly stroked in succession, paying particular attention to the region of the nipple, and, short of producing much pain, the pressure of the finger-tips should gradually be increased.

After this manipulation has been practised for about five minutes and pain is no longer experienced, the operator supports the breast in the palm of one hand placed under the indurated spot, and with the fingers of the other hand this spot is again stroked toward the nipple, using deeper and firmer pressure (Pl. 48, Fig. 2). Each nodule of induration is thus treated in succession.

The palm of the hand is next placed flat upon the inflamed portion of the breast (Pl. 48, Fig. 3), and is then slightly inclined toward the periphery of the breast; steady and gentle pressure is now made downward against the chest-wall, the pressure being greater under the outer margin of the hand—that is, at the periphery of the gland. After a few moments of steady pressure gentle rotary movements of the hand are practised over the lump. Pressure and rotation of the hand are thus alternated for a few minutes or until the patient complains of pain, when the stroking movements (Pl. 48, Fig. 1) are renewed for a short time.

Finally, the breast is grasped firmly with both hands in such a manner as to encircle the breast completely (Pl. 48, Fig. 4); the whole gland is gently raised from the chest and compressed, especially over and at the base of the indurated nodule, and at the same time the two index fingers are quickly stroked toward the nipple, when milk is usually seen to flow from the ducts that empty that portion of the gland. The pressure is not relaxed, so long as the milk flows, until the patient complains of the pain it commonly occasions in a few minutes. After a few moments of rest and reassurance to the patient the manipulations are repeated in the order above described until the whole gland is soft and flaccid, when a pressure-bandage, preferably the Y-bandage, is snugly applied.

Mastitis.—*Frequency.*—It has been estimated that about one-fourth of all fertile married women have suffered from inflammation of the breast at some period of their reproductive activity, and in 1000 consecutive deliveries Winckel[84] observed mastitis in 6 per cent. of the patients. This percentage undoubtedly exceeds the number of cases observed under the more rigid attention in recent years to antisepsis of the nipples and breasts. Deiss[85] records a frequency of 3.6 per cent. in 1600 consecutive confinements. The disease is more frequent in primiparæ. It is said to be observed oftenest in blondes and in lymphatic subjects. It is rare after the fourth pregnancy (Delbert). There are four periods of the puerperium in which mastitis is most likely to occur.

These periods are: (*a*) the first month of the puerperium (especially the first two weeks), while both the mother's nipples and breasts and the infant are adapting themselves to the mammary function; (*b*) when suckling is suddenly given up, thus favoring stasis and its ill effects; (*c*) the period of appearance of the first teeth, at which time the nipple is again exposed to injury; (*d*) and the time of weaning, when either engorgement of the gland is likely to occur because the regular emptying of the breast is not attended to, or, as happens especially in hyperlactation, the child, not being satisfied with the quality and quantity of milk secreted, shows its dissatisfaction by biting and tugging at the nipple.

Varieties.—It is customary to describe three varieties of mastitis, according to the location of the inflamed area. The first and most frequent variety is the *parenchymatous* or *glandular*, in which the acini of the gland or the adjacent connective tissue is primarily attacked by inflammation (Fig. 151). In either case the destructive inflammation, as it progresses, may end by involvement of both the acini and the connective tissue. A second variety is the *subcutaneous*, in which the connective tissue lying immediately beneath the skin is attacked. The third variety is the rare and insidious inflammation of the *post-mammary* or *subglandular* connective tissue between the gland and the chest-wall. This division of mastitis should not obscure the fact that clinically two or all three varieties may be combined, especially in cases which do not receive prompt treatment in the beginning, since either variety may end in a combination of all three. Mastitis commonly begins as the parenchymatous variety and approaches the skin-surface of the gland.

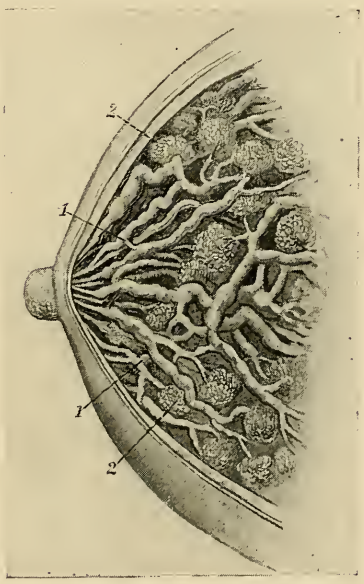

FIG. 151.—Mammary gland: 1, lacteal ducts; 2, glandular acinus (Playfair).

Etiology and Pathology.—The etiology of puerperal inflammations of the breast has actively been discussed in recent years, and, although the investigations of bacteriologists have wrought a change in our notions of the pathology of mastitis, the subject is not wholly free from uncertainty. Formerly it was believed that engorgement of the gland with stasis of the milk was invariably the cause of all mammary inflammation; but this idea has disappeared largely, since most pathologists consider inflammation, wherever found, of microbic origin. Recent experiments have shown that stasis of the milk will not produce mastitis except when the milk contains bacteria. Ligation or stoppage of the milk-ducts by collodion (Kehrer) failed to produce inflammation of the breast in animals. The extreme

rarity of mastitis in supernumerary breasts, and the fact that the frequency of the disease has been lessened so greatly since antisepsis has been extended to the care of the breasts, have also been advanced as arguments in favor of the unimportance of stagnation of the milk. There is, however, a clinical side to this question, which forces the belief that milk-stasis continues at least a predisposing factor in mastitis, especially in the very important parenchymatous variety. Stasis certainly is a frequent precursor of mastitis, whether the accumulation of milk in the gland results from hypersecretion, from failure to nurse at proper intervals, or from insufficient emptying of the gland when there is anatomical defect in the shape of the nipples or narrowing of their milk-ducts—all of which conditions are known to bear an intimate relation to breast-inflammation. Honigman[86] disproved the statement that human milk has bactericidal properties as regards the micro-organisms commonly found in mastitis; further, it is believed that a pent-up milk-secretion not only lessens the resistance of the breast-tissues against microbe activity, but that it also offers a very favorable medium for the rapid multiplication of bacteria. The experiments of Cohn and Neumann, before referred to,[87] demonstrate the fact that the micro-organisms ordinarily found in the milk are more numerous the longer the time since the removal of the milk. Although we must admit that stasis of the milk predisposes to mastitis, the evidence is overwhelming that the important element in etiology is infection.

Since the investigations in 1884 of Bumm,[88] bacteriological studies of mastitis and mammary abscess have proved that these diseases are the result of the irritant action of micro-organisms, and that the infection is usually due to *staphylococci*, either *aureus* or *albus;* sometimes *streptococci* are found; and Monnier[89] has shown that in some cases *staphylococci* are associated with other micro-organisms, such as *micrococcus tetragens*, *streptococcus*, or *micrococcus subflavus*. Thus it will be seen that the disease, like infection of the parturient tract, may originate from several different pathogenic organisms. The nipples, especially when eroded or fissured, are commonly the point of entrance of the infecting agent, and the sources of infection are either the child's mouth, which is known to be the habitat of several micro-organisms some of which are pathogenic, or the patient's or nurse's fingers, or unclean appliances used about the nipple and breast, such as soiled cloths or an unclean nipple-shield or breast-pump. The exact manner of entrance into the breast of the infecting agent in all cases is not definitely settled, and the question is one about which there has been, and is, considerable controversy. It seems certain that the poison may, under varying circumstances, enter the gland either from the cutaneous surface through the milk-ducts, which path many pathologists believe to be most frequent, or through the lymphatics; or, circulating in the blood, the infecting poison may be excreted by the milk. The frequency of involvement of the lower segment of the gland, and the fact that in the early stage of mammary abscess pus and milk are so often coincidently expressed through the nipple by massage, are thought to be evidences of the more frequent early involvement of the milk-ducts (Delbert). When cracks or fissures of the nipple are present, Pingat

believes the poison is likely to enter the lymph-channels; and when the epithelium of the nipples is intact, the microbes may follow the milk-ducts to the acini, there multiply, and find their way into the cellular tissue. Orth thinks it probable that *streptococci* enter the lymph-channels and that *staphylococci* enter the milk-ducts. Williams remarks:[90] "As to the respective parts played by the lymphatics and ducts it is not easy to decide. It seems certain, however, that each has its *rôle*. In superficial inflammations of the breast, especially those of erysipelatous origin, most pathologists are agreed that the lymphatics are chiefly concerned in the spread of the disease. In other cases it seems probable that infection takes place chiefly by the ducts." The relative importance of the ducts and the lymphatics as pathways for the entrance of infection at first thought would seem to be a problem more of scientific interest than of practical value, since it is enough for prophylaxis to know that infection almost always occurs through the nipple, usually when the integument is broken, but possibly when the latter is intact. It will, however, be pointed out later, when the treatment of mastitis is considered, that for one means of treatment—namely, massage—it is of importance to learn, if possible, through which channel the infection has occurred.

The rarest and perhaps the least important channel of infection of the breast is by micro-organisms circulating in the mother's blood-current. It has been shown by Escherich[91] that micro-organisms in the blood-current are often eliminated by the secretions, notably in the milk as well as in the urine. It is possible also that secondary to puerperal phlebitic infection of the genitalia a metastatic abscess of the breast can occur. Beyond these two facts little is known of mastitis and mammary abscess originating from infection of the mother's blood.

The actual pathological changes resulting from infection in and about the parenchyma of the gland are such as would be expected from micro-organisms rapidly multiplying and finding their way into the adjacent tissues. According to Bumm,[92] the milk is fermented, its sugar converted into lactic and butyric acids, and coagula of casein are formed containing innumerable bacteria. The epithelium lining the gland becomes swollen, desquamates, and disappears. At the same time leucocytes and micro-organisms infiltrate the periglandular tissues. Small foci of suppuration soon become numerous, coalesce, and form larger purulent collections. The cavities thus formed are traversed by shreds of partially destroyed tissues, and are surrounded by a protecting wall of leucocytes to prevent the further progress of microbe invasion and suppuration.

Symptoms.—All varieties of mastitis are accompanied by the signs of inflammation. The patient complains of chilly sensations or has a distinct rigor, followed by elevation of the temperature and by pain and tenderness in the affected breast. Each variety, however, has a train of symptoms more or less distinct. It will therefore be of clinical value to describe first the parenchymatous variety, which is the most frequent. Subcutaneous and subglandular mastitis are so commonly followed by suppuration that their description seems more appropriate in the section upon *Mammary Abscess.*

When the inflammation begins in the glandular structures of the breast there will be found one or more hard, localized, tender nodules due to stasis of the milk in these portions of the gland. The overlying skin is either not reddened or there may be only a faint tinge of redness. The pain produced by handling the breast is not severe. The temperature promptly rises to a great height—often to 104° F. or higher. The infection which has taken place through the lactiferous ducts is at this time producing those changes in the milk and the epithelium of the acini that have been described, and when prompt abortive treatment is not employed the more extensive inflammatory changes extending into the connective tissue are likely to occur.

Should the connective tissue surrounding the acini of the gland first become inflamed, an enlarged nodule is at this time not so apparent. The patient complains of an ill-defined painful spot, the temperature rises more gradually, and chilly sensations are complained of oftener than a rigor. The nipple has either recently been sore or will be found eroded or fissured, or upon close inspection a crack or an abrasion is observed at some portion of the areola. There is early redness of the skin that is soon followed by edema. It will frequently be noted that the location of the inflammation corresponds with the situation of the fissure of the nipple. Notwithstanding early treatment, this variety is more likely to resist resolution, the inflammation slowly progressing to abscess-formation, a termination especially liable to follow when the nipple is angrily inflamed and resists treatment.

The clinical signs above described are often clearly distinguishable. There are cases, however, in which both the acini and the surrounding connective tissue are apparently almost coincidently affected, and the differentiating symptoms are correspondingly obscure. When there is doubt as to the exact variety of inflammation, it is a safe clinical rule to institute the treatment to be described for infection of the gland-acini.

Treatment: Prophylaxis.—The prophylactic treatment of mastitis should begin in the last months of pregnancy. Proper attention to the nipples, as previously described, to get them in the best possible condition for suckling, will do much to prevent inflammation of the breasts. From the first application of the child to the breast three important means of prophylaxis are always to be borne in mind, and are to be impressed upon the mother or the nurse; they are: (1) The strictest cleanliness of the breasts and nipples throughout the entire period of lactation; (2) limitation of injury to the nipples by prompt measures to maintain their epithelium intact; (3) prevention of stasis of the milk secreted.

Curative Treatment.—When, notwithstanding all these precautions, inflammation of the gland actually exists, the indications are to put the gland absolutely at rest, to relieve it from tension and from the accumulated products of inflammation, to prevent further engorgement with milk, and, finally, to lessen its blood-supply.

The first and always essential step in treatment, especially when the nipple is sore, is the immediate removal of the infant from the breast, to secure rest

from pain and from functional activity of the gland, to promote healing of the nipple when eroded by avoiding traumatism and fresh infection, and, further, to avoid the danger to the child, slight though it may sometimes be, of absorbing milk changed in quality by the products of inflammation or even containing pus. This being effected, much has been done to prevent abscess-formation; the only advantage of suckling—removal of the milk—can be accomplished more safely and less violently by other means. The next step in the treatment will be to decide whether or not the inflammation is situated in the gland-acini, and whether the inflammation has so far advanced that efforts to prevent suppuration will likely fail. If these two problems could readily be solved, the selection of treatment to be followed in individual cases would not be difficult.

As has been stated above, the manner of onset, the condition of the nipple, the temperature, the character of the pain, the appearance and feel of the breast, and the relative frequency of parenchymatous and interstitial inflammation will often help a decision. When there is doubt, it is best to consider the case, at least temporarily, as one of parenchymatous inflammation. It is perhaps more difficult to determine whether or not the inflammation has advanced beyond the usefulness of abortive measures—in other words, whether or not pus-formation has occurred. When early improvement does not follow prompt and vigorous treatment, but, on the contrary, the case gets steadily worse and presents some of the signs to be described as evidences of abscess-formation, curative treatment short of surgical measures is not to be employed.

Having decided that the inflammation is largely parenchymatous, accompanied and aggravated by inspissation of milk, evacuation of the milk is to be obtained by skilfully applied massage, assisted by the proper use of the breast-pump, bearing in mind the fact that as the breast-pump only withdraws the milk from the large ducts near the nipple, too vigorous application of the pump should not be employed. Short of producing pain, the breast-pump is a valuable adjunct to massage, and the two, skilfully combined, will often more readily empty the breast than will massage alone. Evacuation of the milk and relief of the tension in the breasts having been accomplished, further accumulation should be prevented by firm compression of the breasts. The lessening of blood-supply to the gland and the prevention of hypersecretion are also indicated, and are obtained by the derivative action of saline cathartics, which, to accomplish most good, should be given freely in the earliest stage. After this time their value in large doses progressively diminishes in cases seriously threatened, since an advantage is lost if the flow of milk is thereby almost wholly stopped, for the outflow of milk at the same time relieves the gland of the products of microbe activity.

After the employment of massage and compression of the breast the application of an ice-bag[93] to the binder over the painful lobe of the gland will further lessen the blood-supply and relieve the pain, and will have the well-known beneficial effect of cold upon the inflamed area, whether or not this effect is gained, as has been asserted, through its inhibitory power over the activities

of micro-organisms. The ice-bag may be kept in place continuously for from twelve to twenty-four hours, the time being determined by the disappearance of pain and a fall in temperature. Thereafter it may be used intermittently during from three to six hours, until all tenderness of the breast disappears and the normal milk-flow is re-established.

In addition to employing the ice-bag, or when, as rarely happens, it is disagreeable to and not well borne by the patient, the application under the binder of compresses wet with lead-water and alcohol (2 parts to 1) and covered with waxed paper is a most valuable means of allaying inflammation and relieving pain.

When the inflammation of the breast is thought to have had its origin in the connective tissues about the acini of the gland, the plan of treatment to be followed is somewhat different from the preceding treatment. In the first place, moderate support of the breasts, best obtained by the Murphy binder, should be employed, and not the firm compression of the breasts so useful in parenchymatous inflammation. Again, massage of the breasts can only be productive of harm in the interstitial inflammation, since the relief of milk-stasis is not so urgent and the tissues are further damaged by the manipulation. It is the failure to recognize this class of cases, in which expression is contraindicated, that has helped to make some authors condemn massage of the breasts. When the operator is in doubt as to the variety of inflammation present, or when the case presents evidence of both varieties of mastitis, as sometimes happens, and, it is to be confessed, makes a differential diagnosis difficult, it is best to resort to massage tentatively, giving it up and deciding that interstitial mastitis is present when by its use pain is not diminished and the temperature fails to fall. Abandoning firm compression and all efforts at expression, attempts may be made to combat the inflammation by the use of saline cathartics and by applying under the binder lead-water and alcohol or, which is of doubtful utility, belladonna, either the extract or the plaster. Should belladonna be used, its physiological action upon the pupils, the skin, and the throat must always be looked for, and the drug must be discontinued before a poisonous amount is absorbed. The erosion or fissure of the nipple should promptly be treated, and be cured as speedily as possible. Notwithstanding active treatment, suppuration of the breast is very likely to be the outcome of interstitial mastitis.

Mammary Abscesses.—Following the classification of mastitis, abscesses in the mammary gland may be located superficially under the skin or deeply under the gland; or most frequently the abscess follows mastitis, involving primarily, as has been pointed out, either the secreting structures of the gland or the connective tissue adjacent to the acini, and gradually approaches the skin. Two or even all three varieties may be associated. The parenchymatous variety, approaching and finally involving areas of the subcutaneous connective tissue, where pointing occurs, is most frequently seen. Deep-seated abscesses not vigorously treated by early and thorough opening may burrow in all directions and destroy the gland, or several portions of the breast may successively be attacked when incision and drainage have not been efficient.

Parenchymatous Abscess.—When the inflammation, aggravated by inspissation of the milk, originates in and is limited to the acini of the gland, active and persistent treatment by massage and compression will usually be followed by resolution; or sometimes the pain, induration, and fever will disappear, and after three or four days caseous milk and a small amount of pus will be expressed with the milk. The appearance of the latter is evidence that the inflammation has not wholly been aborted. If, on the contrary, the signs of inflammation do not disappear notwithstanding active treatment, it may be concluded that the interstitial tissues of the breast are either primarily or secondarily involved, and that we have to deal with the most frequent type of mammary abscess and one of the most painful and distressing complications of the puerperium. At the earliest possible moment the formation of pus should be discovered.

Symptoms.—There are, unfortunately, no absolute signs of suppuration short of fluctuation, yet in deep-seated or in slowly progressing cases it is dangerous to delay treatment until fluctuation is apparent. Left to itself, the pus will require about two weeks, or longer when deeply seated, to reach the surface. Frequently the abscesses are multiple and form in succession, and when neglected may recur for months. Velpeau observed 46 abscesses in one breast within a period of two or three months. The signs suggestive of abscess-formation are recurrence of a chill or a chilly sensation; greater rapidity of pulse; persistently high temperature; increasing dull pain in the breast; pain upon moving the arm, sometimes with enlargement and tenderness of the axillary glands; diminution in the flow of milk; bluish-red discoloration, with bogginess, adherence, and marked edema of the skin. Of these signs, rapid pulse, bluish discoloration and edema of the skin, and marked diminution in the flow of the milk are most important, and are enough to warrant an exploratory incision. It should be remembered that some fortunately rare cases of mammary abscess develop subacutely, without the ordinary signs of suppuration, or even of inflammation. The use of an aspirator-needle has been recommended for the detection of pus, although it is often of doubtful utility. Since, to be effective, the needle always requires the preliminary use of an anesthetic, and since it may not find pus-collections which can be found by the finger through an incision, the aspirator-needle should be discarded for the more intelligent and less uncertain exploration with the finger.

Treatment.—The patient should always be anesthetized to open and treat a mammary abscess properly, except when the abscess is superficial or is about to point, in which cases a chlorid-of-ethyl spray or freezing with an ice-and-salt mixture will usually be sufficient. After rendering the skin thoroughly aseptic the breast is grasped, and by careful palpation the collection of pus should, if possible, be localized, and at its most dependent portion there is made, in a direction radiating from the nipple to avoid the milk-ducts, an incision sufficiently large to admit the finger and deep enough to incise only the skin and the subcutaneous tissues (about $\frac{1}{2}$ to $\frac{3}{4}$ of an inch). Through this opening a grooved director is gently passed in all directions until the

abscess-cavity is found, when a dressing-forceps is introduced, by which the tissues are sufficiently dilated to admit the index finger into the abscess-cavity. With the finger all communicating and adjacent cavities are searched for and are freely opened and all friable tissue is broken down. The dressing-forceps or a probe is introduced, is pushed through the cavity to the skin-surface, and is cut down upon to make additional openings in order to secure free drainage. Several such openings should be made in the skin at the different portions of the gland where pus or induration has been detected by the finger.

After thoroughly dilating all entrances to the pus-cavities, thorough irrigation is made with an antiseptic solution. Peroxid of hydrogen, full strength, followed by a 2 per cent. solution of creolin, will be found efficacious. Weak solutions of carbolic acid or of bichlorid of mercury may be used. The subsequent treatment may be one of the following: The cavities and all openings may be packed firmly with sterilized gauze moistened by an antiseptic solution (1 per cent. carbolic or 2 per cent. creolin), followed by an antiseptic dressing under a firm bandage. After from twenty-four to thirty-six hours the gauze packing is gently removed, the cavities are irrigated with the peroxid of hydrogen diluted with three volumes of boiled water, followed by creolin (1 per cent. solution); strips of gauze are lightly placed in the drainage-tracts, and a compression binder is comfortably applied. The next day, if the discharge has almost disappeared, an antiseptic dressing is applied, and firm compression is secured by carefully-adjusted compresses placed under the bandage. A large aseptic bath-sponge,[94] slightly hollowed to fit the breast and wrung out in a bichlorid or creolin solution, will provide firm and equable pressure under a very tight roller bandage; or the Y-binder may be employed, supplemented by a strip of muslin drawn tightly across both breasts to compress the summits of the breasts. Care should be taken to lift the breasts slightly toward the clavicles when the binder is applied. The antiseptic solution is poured under the edge of the binder often enough to keep the sponge moist. The sponge dressing is removed each day thereafter and the breast externally is gently washed. On the eighth or the tenth day the cavities and the tracts leading to them will usually be closed, when the sponge compression may be discontinued. If the openings have not united, their edges may be brought together with adhesive strips or with collodion.

If drainage is desired by means of drainage-tubes, perforated rubber tubes at least one-fourth of an inch in diameter should be drawn through the openings after irrigation, and a firm binder should be applied over an antiseptic dressing. The next day the dressings should be renewed after irrigating the cavities, and the dressing may now be left undisturbed for four days; then the tubes should be shortened one-half their length, the cavities be irrigated, and the dressing be reapplied. So long as the pus is thick and tenacious the tubes will afford better drainage than strips of gauze, but if the progress of the case will permit, gauze should be substituted, otherwise the tubes should gradually be shortened, and they may be removed entirely by the end of at least ten days or two weeks. The disadvantage of the drainage-tubes is the tendency on

the part of the physician to allow them to remain in the breast too long, and thus to cause fistulæ. The amount and character of the discharge and the disappearance of the cavities in the breast will indicate how soon the tubes may safely be removed.

The child, of course, must not be nursed from the diseased breast, but may be applied to the sound breast in order to keep up the milk secretion, provided the mother's general health does not indicate the desirability of weaning.

Convalescence is promoted by the administration internally of tonics, particularly quinin, strychnia, and iron.

Subcutaneous Abscess.—Subcutaneous inflammation of the breast is usually followed by the formation of an abscess, and it always results from infection through the superficial lymphatics, the septic material finding entrance into the lymphatics through erosions of the nipple or through a breach in the continuity of the areola or the adjacent skin. Usually the inflamed area is circumscribed; the overlying skin rapidly becomes very red, the temperature is elevated, and within a few days fluctuation is discovered, announcing the prompt occurrence of suppuration. The prevention of this form of inflammation is obtained by cleanliness of the breasts and nipples. In the beginning of the inflammation the administration of a saline cathartic and the application of compresses saturated with lead-water and laudanum, with or without an ice-bag, and held in place by a mammary binder without compression, will afford relief. At the first appearance of suppuration an incision should be made, either wholly within or outside the pigmented areola, to avoid an unsightly scar; the abscess-cavity should be irrigated with hydrogen peroxid, full strength or one-half diluted, followed by a creolin or a bichlorid solution, and after introducing a gauze drain a firm binder should be applied.

A diffuse inflammation of the subcutaneous connective tissue sometimes occurs, which condition is much more serious, but fortunately, is now very rare. It is usually, but not always, preceded by erysipelatous inflammation of the overlying skin, and is accompanied by chills, high fever, and severe burning pain. The axillary glands are often tender and swollen. The subcutaneous connective tissue quickly suppurates, and when not promptly treated by incision, drainage, and thorough antisepsis, extensive sloughing occurs, which may be followed by general pyemia and death. In the earliest stage the application of compresses wet with creolin solution (10 per cent.) or with lead-water and laudanum will be useful, but these compresses must not interfere with early recognition and evacuation of subcutaneous collections of pus.

Submammary Abscess.—In rare instances empyema or suppuration resulting from disease of the ribs may perforate the tissue under the mammary gland and produce an abscess situated beneath the mammary gland; but in the puerperium submammary abscesses practically always result from burrowing toward the chest-wall of a parenchymatous abscess. Several pockets of pus may thus be formed beneath the gland and at its periphery; the pus-cavities communicate after a few days, and the breast is lifted from the chest, the gland feeling as if it rested upon a fluid base, its overlying skin becoming tense, but usually not

red. This variety of mammary abscess, the rarest, is of very great importance, because if overlooked most serious consequences may follow before spontaneous evacuation of the pus occurs. The inflammation of the connective tissue, which almost never undergoes resolution, may spread to the abdomen, to the other breast, and to the axilla, and pus may burrow in all directions, sometimes even attacking the ribs and perforating into the pleural cavity. The *symptoms* are not characteristic, since the deep-seated pain, the high fever, the edema of the overlying and adjacent skin, the restricted motion of the arm on account of the pain, and the involvement of the lymphatics in the axilla may be present in parenchymatous abscess, although these symptoms are usually less marked in the latter variety. The absence of marked redness of the skin and the peculiar sensation imparted to the gland by the underlying fluid collection are the most characteristic signs.

Treatment.—When this variety of abscess is suspected, the location of the pus-collections may be searched for with a sterilized aspirator-needle. After thoroughly disinfecting the skin, the patient ordinarily being etherized, the breast should be pushed toward the clavicle and the needle held parallel with the chest-wall, and, entering the skin on a level with the lower margin of the pectoral muscle in the infra-axillary region, should be thrust deeply beneath the gland. When the pus is located there is passed into the cavity a grooved director, which will serve to guide a pair of scissors or dressing-forceps, the blades of which, after being introduced, are separated and forcibly withdrawn. The cavity is then explored with the finger and adjacent pockets of pus are opened, especial care being taken to find and enlarge the opening or openings between the submammary and parenchymatous abscesses. Irrigation, drainage, and antiseptic dressings should then be employed as in other varieties of mammary abscess.

Abscesses in the Areola.—The glands of Montgomery and the connective tissue beneath the areola sometimes become infected, and the result is the formation of small and usually superficial abscesses. The abscesses are most frequently observed when the nipple is inverted or stunted, thus compelling the infant to take into its mouth a portion of the areola in order to get a better grasp of the nipple. The skin at first reddens; the glands become hard and more prominent, and, pointing at yellow spots in their centres, finally perforate the skin at one or more places, leaving excavated ulcers surrounded by an indurated wall of lymph. These nodules may remain for several weeks, or, receiving fresh infection, they may break down, the ulceration being followed by an ugly scar.

Treatment.—Care of the nipples will usually prevent infection of the glands. Each gland when inflamed should be incised and touched with a strong bichlorid solution, after which the edges of the incision are approximated, covered with a narrow strip of gauze, and held together by a collodion dressing. Nursing need not be discontinued.

Prognosis and Sequelæ of Mammary Inflammation.—Mammary abscess is rarely directly dangerous to life. Fatal termination has been recorded from hemorrhage due to erosion of blood-vessels (Jacobus) and from septi-

9. Anomalies in the Milk-secretion.

In this section will be considered the following abnormalities associated with the mammary function: (*a*) secretion of milk abnormal in quality or in quantity, and the effect of either of these changes upon the health of the mother or of the child; (*b*) conditions interfering with the performance of the mammary function; (*c*) weaning; and (*d*) the ill effects of prolonged lactation.

Abnormalities in Quality.—The quality of the milk of the nursing mother is influenced by many conditions; and while variations may be observed in the proportion of any or of all of its constituent elements, or even in the presence of foreign elements, the proportion of fat and albuminoids under ordinary circumstances shows the greatest and most important variations. The proportion of sugar is remarkably constant under all circumstances, and there is very little variation in the percentage of salts. A very common cause of impairment in the quality of the milk-secretion is a failure to give proper attention to the time of putting the infant to the breast. Nursing at too frequent, prolonged, or irregular intervals materially alters the condition of the milk, and renders it either difficult of digestion or of poor nutritional value. A very common mistake made by inexperienced mothers is the frequent application of the child to the breast when it is restless, under the mistaken idea that the infant requires more food, when, as a matter of fact, an excess of food, with consequent indigestion, or thirst, is the real cause of the child's discomfort. When the breast is given to the child at shorter intervals than two or three hours, the milk rapidly becomes more concentrated, and therefore is digested with great difficulty. On the contrary, when a longer interval between nursings is permitted, the solids of the milk are so reduced as seriously to diminish its value for nutrition.

Perhaps the most important factor influencing the quality of the milk is the diet of the nursing mother. A diet largely vegetable will increase the proportion of sugar and diminish that of fat and caseinogen, while an excess of albuminous food will increase the fat and caseinogen and diminish the proportion of sugar. In each case the infant receives food ill adapted to its needs, and will either be poorly nourished or, when the fat and caseinogen are in excess, there will soon appear digestive disturbances with their associated dangers. The employment of alcoholic and malt liquors will also lead to an excess of fat and caseinogen. There is a widespread belief, not only among the laity but also among the profession, that the nursing mother should add to her diet some preparation of malt to improve the quality of her milk. While it is true that in exceptional cases distinct benefit is thus to be obtained, the indiscriminate use of such preparations certainly does more harm than good. Zaleski[95] found that not only were fat and albumin increased in the milk of mothers taking malt, but that the milk sometimes actually contained alcohol and the micro-organisms peculiar to malt liquors. Klingeman[96] learned from his investigations that when the nursing mother took alcohol in moderate quantity there was no evidence of its presence in the milk. When the quan-

tity ingested was increased, a small amount of alcohol passed into the milk, which amount he thought was usually insufficient to have an ill effect upon the suckling. The changes produced in the constituents of the milk, however, were quite noticeable, and Strumpf is quoted as authority for the statement that alcohol taken by the mother so changes the fatty and albuminoid contents as to diminish the nutritional value of the milk. The milk should be known to contain too little fat and caseinogen before recommending the use of malt; and when malt is taken, the first appearance of digestive disturbance in the infant calls for either a reduction in the amount ingested or for complete abstinence. As a matter of experience it is in the latter half of the lactation period that the mother's milk is more likely to be deficient in the constituents for whose increase a malt preparation is indicated, and the common practice of advising mothers to drink stout or other malt liquors shortly after labor is certainly reprehensible in a very large number of cases. Careful analyses of the milk may be made at intervals, to determine the proportion of fat and albumin, and these analyses will indicate the desirability of administering or withholding malt, and will often indicate other desirable changes in the diet.

The diet of the nursing woman should ordinarily not differ materially from that to which she has previously been accustomed. It should consist of plain mixed food with a moderate excess of fluids. Of the latter, milk taken between meals is useful; tea and coffee are best withheld or taken in moderation and largely diluted; cocoa is sometimes useful.

When the child does not thrive upon its mother's milk, or when it presents serious digestive derangements, a chemical analysis of the milk should be made. Having decided upon a chemical examination of the milk, it should be borne in mind that the relative proportion of the constituents of the milk varies with the time of its withdrawal from the breast. The first portion removed contains a smaller, while the last will show a larger, portion of solids, hence the specimen should be taken after the infant has about half-emptied the breast. Since each mammary gland may yield a different quality of milk,[97] and since the quality of the milk also varies at different intervals, several specimens from both glands should be subjected to analysis to obtain an absolutely accurate estimate of the quality of the milk.*

* If it is impossible to obtain an analysis by an expert chemist, the following method, suggested by Nias,[98] and considered by him sufficiently accurate for clinical purposes, may be employed to estimate the amount of fat and albuminoids: Add enough liquor potassæ to the sample of milk to render it distinctly alkaline; place in a test tube, boil, and set aside in a warm room for a few hours. The fat will rise to the surface, and the amount may be estimated by a graduated rule placed at the side of the tube. To determine the amount of albuminoids, remove the layer of fat with a pipette, add sufficient acetic acid to the remainder to render it acid, boil, and again set aside in a warm room. All the albuminoids will be precipitated, and may be estimated in the same manner as the fat. There may be used with advantage a test-tube graduated in hundredths, in which a sample of milk known to be normal has been tested by this examination, and thus offers a standard for comparison. With this modification the writer has found this method useful for approximate analysis. The method of Holt[99] may also be used for the estimation of the percentage of fat and for detecting wide variations in the percentage of proteids.

9. Anomalies in the Milk-secretion.

In this section will be considered the following abnormalities associated with the mammary function: (*a*) secretion of milk abnormal in quality or in quantity, and the effect of either of these changes upon the health of the mother or of the child; (*b*) conditions interfering with the performance of the mammary function; (*c*) weaning; and (*d*) the ill effects of prolonged lactation.

Abnormalities in Quality.—The quality of the milk of the nursing mother is influenced by many conditions; and while variations may be observed in the proportion of any or of all of its constituent elements, or even in the presence of foreign elements, the proportion of fat and albuminoids under ordinary circumstances shows the greatest and most important variations. The proportion of sugar is remarkably constant under all circumstances, and there is very little variation in the percentage of salts. A very common cause of impairment in the quality of the milk-secretion is a failure to give proper attention to the time of putting the infant to the breast. Nursing at too frequent, prolonged, or irregular intervals materially alters the condition of the milk, and renders it either difficult of digestion or of poor nutritional value. A very common mistake made by inexperienced mothers is the frequent application of the child to the breast when it is restless, under the mistaken idea that the infant requires more food, when, as a matter of fact, an excess of food, with consequent indigestion, or thirst, is the real cause of the child's discomfort. When the breast is given to the child at shorter intervals than two or three hours, the milk rapidly becomes more concentrated, and therefore is digested with great difficulty. On the contrary, when a longer interval between nursings is permitted, the solids of the milk are so reduced as seriously to diminish its value for nutrition.

Perhaps the most important factor influencing the quality of the milk is the diet of the nursing mother. A diet largely vegetable will increase the proportion of sugar and diminish that of fat and caseinogen, while an excess of albuminous food will increase the fat and caseinogen and diminish the proportion of sugar. In each case the infant receives food ill adapted to its needs, and will either be poorly nourished or, when the fat and caseinogen are in excess, there will soon appear digestive disturbances with their associated dangers. The employment of alcoholic and malt liquors will also lead to an excess of fat and caseinogen. There is a widespread belief, not only among the laity but also among the profession, that the nursing mother should add to her diet some preparation of malt to improve the quality of her milk. While it is true that in exceptional cases distinct benefit is thus to be obtained, the indiscriminate use of such preparations certainly does more harm than good. Zaleski[95] found that not only were fat and albumin increased in the milk of mothers taking malt, but that the milk sometimes actually contained alcohol and the micro-organisms peculiar to malt liquors. Klingeman[96] learned from his investigations that when the nursing mother took alcohol in moderate quantity there was no evidence of its presence in the milk. When the quan-

tity ingested was increased, a small amount of alcohol passed into the milk, which amount he thought was usually insufficient to have an ill effect upon the suckling. The changes produced in the constituents of the milk, however, were quite noticeable, and Strumpf is quoted as authority for the statement that alcohol taken by the mother so changes the fatty and albuminoid contents as to diminish the nutritional value of the milk. The milk should be known to contain too little fat and caseinogen before recommending the use of malt; and when malt is taken, the first appearance of digestive disturbance in the infant calls for either a reduction in the amount ingested or for complete abstinence. As a matter of experience it is in the latter half of the lactation period that the mother's milk is more likely to be deficient in the constituents for whose increase a malt preparation is indicated, and the common practice of advising mothers to drink stout or other malt liquors shortly after labor is certainly reprehensible in a very large number of cases. Careful analyses of the milk may be made at intervals, to determine the proportion of fat and albumin, and these analyses will indicate the desirability of administering or withholding malt, and will often indicate other desirable changes in the diet.

The diet of the nursing woman should ordinarily not differ materially from that to which she has previously been accustomed. It should consist of plain mixed food with a moderate excess of fluids. Of the latter, milk taken between meals is useful; tea and coffee are best withheld or taken in moderation and largely diluted; cocoa is sometimes useful.

When the child does not thrive upon its mother's milk, or when it presents serious digestive derangements, a chemical analysis of the milk should be made. Having decided upon a chemical examination of the milk, it should be borne in mind that the relative proportion of the constituents of the milk varies with the time of its withdrawal from the breast. The first portion removed contains a smaller, while the last will show a larger, portion of solids, hence the specimen should be taken after the infant has about half-emptied the breast. Since each mammary gland may yield a different quality of milk,[97] and since the quality of the milk also varies at different intervals, several specimens from both glands should be subjected to analysis to obtain an absolutely accurate estimate of the quality of the milk.*

* If it is impossible to obtain an analysis by an expert chemist, the following method, suggested by Nias,[98] and considered by him sufficiently accurate for clinical purposes, may be employed to estimate the amount of fat and albuminoids: Add enough liquor potassa to the sample of milk to render it distinctly alkaline; place in a test tube, boil, and set aside in a warm room for a few hours. The fat will rise to the surface, and the amount may be estimated by a graduated rule placed at the side of the tube. To determine the amount of albuminoids, remove the layer of fat with a pipette, add sufficient acetic acid to the remainder to render it acid, boil, and again set aside in a warm room. All the albuminoids will be precipitated, and may be estimated in the same manner as the fat. There may be used with advantage a test-tube graduated in hundredths, in which a sample of milk known to be normal has been tested by this examination, and thus offers a standard for comparison. With this modification the writer has found this method useful for approximate analysis. The method of Holt[99] may also be used for the estimation of the percentage of fat and for detecting wide variations in the percentage of proteids.

Microscopical examination of the milk to count the number of milk-globules, as proposed by Bouchere and recommended by Kleinwächter, is no longer considered of practical value. This method of analysis cannot take the place of careful chemical analysis. The microscope, however, is sometimes useful—for example, to recognize the presence of colostrum-corpuscles and foreign matters, such as pus, blood, and epithelial cells.

The later and most reliable analyses of human milk show an average composition as follows:

Water	87–88.
Total solids	12–13.
Fat	3–4.
Albuminoids	1–2.
Sugar	7.
Ash	0.2.
Reaction	Faintly alkaline.
Specific gravity	1028–1034.[100]

If the proportion of fat is below the normal amount (3.15 per cent.—Temesvàry),[101] the diet should be modified by reducing slightly the fatty food and increasing the proteids. If, on the contrary, the milk is too rich in fat and albumin, less meat and more vegetables should be given, and at the same time the employment of additional muscular exercise with daily baths is important. A change in diet alone will not reduce the proportion of caseinogen, which is commonly in excess in the upper class of women, without reducing at the same time the other constituents; hence the resort to systematic muscular exercise is essential. Much can often be accomplished by these means to adjust a proper quality and quantity of milk for the child; but not infrequently, despite all efforts, the child's condition fails to improve, and it becomes necessary for its welfare to resort to artificial feeding.

Sudden fright or joy, great anxiety, and other emotions in the mother have a peculiar effect upon the quality of her milk. We have no intimate knowledge of the changes thus brought about, beyond the clinical fact that indigestion and colic are of frequent occurrence in infants nursed by emotional mothers, whose milk, it is asserted, is likely to contain more water, less fat, and more caseinogen than normal. The nursing mother should be made aware of this fact, and be cautioned to lead a life as free as possible from emotional excitement. In extreme cases of emotion the milk can be so changed as to become actually a fatal poison to the child.

The age of the mother and the period of lactation modify the quality of the milk. As the age advances the proportion of albuminoids gradually diminishes, and, beginning with the sixth month, as lactation advances the percentage of proteids becomes somewhat less (Kolesinsky).

An excessive quantity of fat, according to Monti,[102] will appear in the milk when the mother is affected by serious acute pathological processes, as mastitis or any other extensive febrile process. The same observer has sometimes noticed a gradual diminution in the proportion of fat in the presence of

pathological processes of long duration. The qualitative changes in the milk produced by acute febrile diseases, by blood-changes in the mother, by the presence in the milk of micro-organisms, and by the reappearance of colostrum-corpuscles will be referred to in a subsequent section.

Abnormalities in Quantity.—Abnormalities in the quantity of the milk may vary from an entire absence of secretion to an enormously excessive supply, which may even continue after the child has been weaned.

The normal amount of milk secreted by the mammary glands is very difficult to determine, since there are wide individual variations within the limits of health. Temesvàry,[103] in a long series of examinations after lactation had fully been established, found the average amount of milk from one breast to be 59 cubic centimeters (2 ounces), the variations being between 30 and 70 cubic centimeters (1 to 2½ ounces). Ordinarily the total quantity of milk secreted in twenty-four hours is 414 cubic centimeters (14 ounces) at the end of the seventh day; this amount steadily increases for a month, when the quantity has reached about 2 pints, after which time, to meet the demands of the growing infant, it has increased to 3 pints at the seventh month, and after the eighth month the quantity gradually decreases.

Agalactia.—Complete absence of the milk-secretion is of such very rare occurrence that its existence has frequently been doubted. Usually there is only a deficiency which may occur at the beginning and continue throughout the whole period of lactation; or more commonly the secretion, at first sufficient, gradually diminishes in amount or from some intercurrent affection suddenly disappears. The secretion of an abnormally small amount of milk may be due to an anomaly in the formation of the mammary glands, either congenital or acquired from faulty clothing compressing the glands; it is observed also in the very feeble, in women of advanced age, after premature births or stillbirths, and in women who carry an excessive amount of adipose tissue.

Diminution in amount of a secretion previously abundant is a most important and very frequent anomaly of the mammary function. It is often observed in women of the working-classes, who shortly after confinement are compelled to perform an excessive amount of work in the management of their household affairs, and commonly are deprived of nourishment suitable to the formation of a sufficient quantity of milk. When it is remembered that milk-secretion is a physiological function depending, as do other functional activities of the organism, upon the condition of the woman's health, it will readily be seen that any condition unfavorable to the mother's general health will interrupt the activity of the mammary glands. Thus, diminution of the milk is observed when there are unfavorable hygienic surroundings and when vitality is lowered from frequently recurring pregnancies or from intercurrent diseases, especially such as are accompanied by profuse discharges, as diarrhea or excessive menstruation. Temporary diminution or disappearance of the milk occurs when there is high fever and when inflammation of the breast is present.

Treatment.—Insufficient milk due to defective development of the mammary gland practically cannot be increased. In such cases the only recourse is artificial feeding. In very exceptional instances electricity and massage have contributed to awaken a torpid gland to increased activity, but when there exists extensive actual anatomical defects even these agents accomplish little or nothing. Mensinga, however, recorded [104] an interesting case in which persistent massage for a week succeeded in establishing a flow of milk when in six successive pregnancies there had been an absence of milk. In other cases much may be done to increase the quantity and improve the quality of the milk by critically studying the mother's general condition and by giving especial attention to her diet. Her hygienic surroundings should be improved. If there is depressed vitality or ill health from any cause, this must be removed. Benefit often follows a change of air and scene with freedom from care and overwork. The diet should be modified by the addition of milk, farinaceous food, and a proper quantity of malt, and particular attention must be given to the patient's stomach-digestion, to ensure the proper assimilation of her modified and increased diet. Bitter tonics, particularly nux vomica with pepsin and a mineral acid, will often be of value in promoting digestion. More can be accomplished by these means than by any of the so-called "galactagogues," all of which are of doubtful value.

Polygalactia.—A supply of milk greatly exceeding the need of the infant is of rare occurrence. Sometimes at the beginning of lactation the milk is formed in larger quantity than the child requires, but this excess soon disappears and supply and demand are finally equalized. At times, however, in vigorous, plethoric women the milk-secretion is so abundant and is accompanied by so much discomfort to the patient that means must be employed to diminish the flow. This diminution can be brought about by restricting the diet and the amount of fluids ingested, by the administration of salines, by employing compression of the breasts, and by advising longer intervals in putting the child to the breast.

Galactorrhea.—Very excessive secretion of milk of poor quality toward the end of a prolonged lactation, and the continuation of the secretion after the child has been weaned, are included under the term "galactorrhea." As a rule, both breasts are at fault. The quantity of milk secreted is usually sufficiently large seriously to impair the patient's health; in some cases the quantity secreted may be enormous. The cause of galactorrhea is unknown. Relaxation or paralysis of the circular muscular fibres surrounding the milk-ducts has been considered a cause by some authors; by others the condition has been considered to be an effect of extreme physical exhaustion.

Symptoms.—The symptoms, aside from the almost constant flow of milk, are those to be expected when so constant a drain is made on the individual's strength. Nutrition is interfered with; extreme anemia and emaciation are present, and are soon followed by some of the nervous disturbances to be described as accompanying hyperlactation.

Treatment.—Pronounced galactorrhea is a very stubborn affection, often

continuing for a very long time despite treatment. Vigorous compression of the breasts, free action of the bowels, and the administration of iodid of potassium are generally useful. Electricity is often disappointing. Ergot has given good results in some cases, and atropia is said to be satisfactory sometimes, particularly in those unable to stand free purgation. The treatment directed to the patient's general ill health—iron and other tonics and nutritious diet—has doubtless been a large factor in accomplishing the good results claimed for various special agents, as occurred in a case under the care of the writer, who, from the patient's general condition, was impressed with the belief that galactorrhea is perhaps only one expression of a neurosis.

Conditions Interfering with Suckling.—Ordinarily, the condition of the mother that interferes with the performance of the mammary function is one of simple loss of strength and flesh. There are, however, several more definite conditions that may be present at the outset of the lactation period, or that later may develop at any stage of this period. The more important of these complications will be considered briefly in the order of their relative importance.

Faulty Development of the Mammary Glands.—The anatomical structure of the mammary glands may in some individuals be very deficient in the development of the glandular element, connective tissue having replaced the gland-structures to such an extent as to preclude the possibility of the mother supplying sufficient milk for her child. This defect is apparently inherited in rare cases. It is observed in women of ill-developed physique, and may be acquired through undue compression of the mammary glands by faulty clothing, or where the mother in each recurring period of lactation refuses to nurse her child. Little can be done for this condition, and, as a rule, artificial feeding is necessary. Where atrophy of the glandular elements is only partial, electricity, by stimulating the secretory function of the epithelial cells, accomplishes at times some improvement, although it is a measure more often disappointing. The same may be said of massage of the breasts.

Diseases.—At any time throughout the period of lactation temporary cessation of breast-feeding may be necessary by reason of intercurrent disease of the mother. Thus a fissured nipple often requires the withholding of one breast for twenty-four or forty-eight hours, and a mammary abscess will interdict nursing from the diseased breast until complete convalescence is reached. Likewise, the child must be weaned temporarily in any acute disease dangerously depressing the mother's strength or exposing the child to infection, such as the exanthemata, erysipelas, diphtheria, typhoid fever, malaria, and grave puerperal sepsis. When convalescence has been established the milk will usually reappear, and the child should be returned to the breast.

The presence, from any cause, of persistently high fever in the mother is in itself an indication for removal of the child from the breast. Fortunately, Nature usually takes this matter in her own hands, for it is a clinical fact that the milk-secretion soon disappears when the temperature is high and when the milk has thereby become injurious to the child. Schling[105] confirmed the experiments of Fehling, who has shown that within certain limits milk from

a fevered mother has no ill effect upon the child. When the temperature is very high and persists near 104° F., a corresponding fever-curve soon appears in the child—a phenomenon not to be wondered at in the light of investigations which find, as in mastitis, the same micro-organisms in the mother's milk and in the child's intestinal canal.

The experiments of many bacteriologists, notably those of Konigman[106] and of Cohn and Neumann,[107] disprove the notion, formerly so widespread, that a healthy mother's milk comes from the breast absolutely sterile. On the contrary, they have found that the milk of healthy nurses contains micro-organisms in the vast majority of cases. The micro-organism commonly found is the *staphylococcus pyogenes albus;* next in frequency, the *aureus;* and other microbes very seldom and in small number. The microbes find their way into the milk usually from without—probably from the skin into the ducts through their orifices on the nipple. Occasionally, however, the blood-current of the mother afflicted with septic disease is the medium of their entrance into the milk (Escherich, Longard, and Karlinski).[108] Ordinarily the milk containing the cocci commonly found in breast-milk produces no ill effect upon the infant. The investigations above referred to demonstrated that the child's intestines are capable of bactericidal action. The stools of children taking milk known to contain cocci were examined, and it was found that the cocci had been destroyed in the intestine. Cohn and Neumann further remark, however, that we must admit the possibility of infection in weak children, to which infection is to be attributed some of the cases occasionally recorded of abscess-formation in the new-born infant. When the milk happens to carry micro-organisms of more virulent character, as in some cases of mastitis, serious disease in the child may appear. Cases of gastro-intestinal disorders, of diphtheroid stomatitis, and of retropharyngeal and submaxillary abscesses are not uncommon, and even otitis media, dacryocystitis, and purulent ophthalmia have thus originated (Damourette).[109]

The reappearance of the colostrum-corpuscles in the mother's milk, perhaps the most valuable result to be obtained by microscopical examination of the milk, is not only a phenomenon of medico-legal interest, but is also of practical value in determining the quality of the milk, since the presence of these corpuscles after the eighth or the tenth day indicates qualitative changes in the milk which disagrees with the child. We have no intimate knowledge of these changes, nor do we know why the corpuscles reappear. During the first week of lactation these corpuscles are numerous, and their presence at this time is physiological. At various periods throughout lactation they reappear, when the milk is found deficient in nutritive value. They have been observed to reappear when the mother has been affected by some profound nervous impression, such as excessive grief, fright, fatigue, or sexual excitement. Intercurrent diseases, particularly anemia, are often accompanied by their reappearance. Occasionally they are observed during a return of menstruation. It is also a curious fact that drugs administered to a nursing mother more readily pass into the milk during a colostrum period. The reappearance, therefore,

of colostrum-corpuscles in large numbers after the second week of lactation is an indication to at least temporarily discontinue nursing.

The diseases which make permanent weaning necessary are not numerous. Phthisis, either incipient or developed, endangers the mother by rapid advance of the disease, and not only exposes the child to infection by the transfer of the tubercle bacillus in the milk, as in a case clearly demonstrated by Steigenberger,[110] but also adds a risk of ill development on account of the impaired nutritive quality of the milk. A mother known to have syphilis may be allowed to suckle her infant, provided the child bears unmistakable evidences of the disease, and provided also her general condition is such as to furnish a supply of milk of suitable quality and quantity. The testimony of the changes in the ingredients of the milk of syphilitic women, apart from its capability of transmitting the disease, is contradictory, and is doubtless due to the varying condition of general health in those afflicted with syphilis. When, however, the infant has apparently escaped infection, the mother should not be permitted to risk infecting the child by her breast-milk. In this connection it is desirable to remind the student of Colles's well-known law that a mother may suckle her evidently syphilitic child without fear of being herself infected. A syphilitic child should never be given in charge of a wet-nurse without informing the nurse of her danger of infection—a danger and risk so great as to induce Fournier[111] to make the statement that the practice of wet-nursing syphilitic infants should be prohibited by law. It will often be necessary to discontinue nursing when the temperament of the mother is so highly emotional as repeatedly to produce serious qualitative changes in her milk. The existence of or predisposition to goitre contra-indicates suckling, since this disease is thereby aggravated; in some cases goitre has first appeared during the lactation period.

Anemia.—An impoverished condition of the blood after labor renders the puerpera incapable of supplying a proper quality of milk, and further depletes her vitality to such an extent that nursing must be omitted both for her own and for the child's best interests. It is therefore inadvisable to permit suckling to be continued when a profuse hemorrhage has occurred at the time of delivery, or when a condition of advanced anemia has developed during pregnancy, with or without albuminuria, in which case the frequent tardy involution of the blood will be even more delayed. It is, moreover, certainly rational to believe that the blood of an albuminuric woman cannot supply the material for a perfectly healthy milk-secretion.

Return of Menstruation.—Among the laity the notion is very widespread that a return of the menstrual function makes it imperative to discontinue nursing. When the amount of blood lost is sufficient to produce anemia, it will always be desirable to wean the child. Ordinarily the flow is not excessive and may be very irregular, and the impairment of the milk is only temporary, as shown by the transient digestive disturbance in the child. Under such conditions it would certainly be unwise to resort to artificial feeding unless the child's condition clearly indicated that it was not thriving, which sometimes

will be the case when the menses return regularly and profusely. Schlichter's[112] observations, during a period of five and a half months, of 52 children suckled by women in whom menstruation had appeared, found that only one child became dyspeptic, and that this child showed a normal gain in weight. Thirty-three milk-analyses were made, and they showed on an average less difference between the milk of a non-menstruating and a menstruating woman than between the specimens of milk taken from an individual at morning, noon, and evening. The advisability of discontinuing nursing when the menses return should always be decided in individual cases by a critical study of the health of both mother and child.

Pregnancy.—The experience is universal that a mother cannot continue to supply nutriment for both her unborn and her living child; and, leaving out of consideration the possibility of the occurrence of miscarriage through the intimate reflex association of the uterus and the mammary glands, lactation and pregnancy are incompatible, and are not to be sanctioned except when serious illness in the suckling makes a supply of breast-milk specially urgent for a short time.

Drugs.—It is recognized as a clinical as well as an experimental fact that various drugs are in part eliminated by the mammary gland, not only when the milk is in a poor condition, but also when the nursing mother is apparently perfectly healthy. Alcohol, quinin, salicylic acid, arsenic, lead, iodoform, potassium iodid, mercury, the poisonous alkaloids, narcotics, belladonna, and a few other drugs have been found in the milk of nursing women. Knowledge of this subject has largely been gathered from accidents occurring to the infant when the nursing mother has been treated for intercurrent diseases.

Burdel[113] reported fatal illness in an infant whose mother had been cinchonized, and he advises withholding the breast until the milk containing the quinin is withdrawn.

Vinay[114] observed a distinct odor of nicotin, though chemically it was not shown to be present, in the milk of mothers exposed to the vapors of nicotin in tobacco-factories, and he noted the appearance of serious illness in the child upon the mother's return to the factory, which illness disappeared when the milk was given up. Doses of the poisonous alkaloids physiological for the mother may at times pass through the milk in quantity sufficient to be poisonous to the child. This is especially true of atropia.

Fehling[115] and Schling[116] have experimentally studied the action upon the infant of various drugs ingested through the mother's milk, and they point out the fact that the time required for partial elimination by the mammary glands varies with different drugs.

The frequently observed laxative action upon the child of salines or of compound licorice powder administered to the mother is sometimes utilized for the benefit of the infant, but beyond this the writer is acquainted with no exact experimental or clinical studies of the medicinal treatment of infants through the breast-milk. According to Barnes, syphilis in the infant may thus be cured.

Weaning.—As the normal period of lactation is relative, often depending upon individual capacity for the production of milk and for enduring the strain of lactation, it is difficult to name a period throughout which the child should be fed exclusively from the breast. Ordinarily nine months is the limit, but in some individuals lactation may be extended throughout a year without detriment to mother or child. After twelve months the changes in the quality and quantity of the milk, the appearance of teeth in the child, indicating nature's preparation for other food, and the beginning ill effects upon the mother of prolonged lactation, make it imperative to remove the infant from the breast. There are, of course, a few conditions which will allow a continuation of lactation for a brief period beyond twelve months. It would, for example, be unwise to wean a child at the approach of midsummer, or when it had recently recovered from a serious illness, or when in the midst of a dental period. Whenever weaning is decided upon, it is best, as a rule, though not always necessary, to give artificial food gradually, substituting at first one or two bottle-feedings daily, and gradually increasing the number until finally, in the course of several weeks, the breast-milk is no longer used. At the end of the sixth month it is a good rule to investigate the quantity and quality of the mother's milk and the condition of the child, and to observe the effect of lactation upon the mother's health. If, as is quite common, this investigation indicates the desirability of weaning, this should be begun, and by the end of the ninth month the breast-milk may be omitted.

Hyperlactation.—Prolongation of the lactation period beyond the usual time for weaning—from the ninth to the twelfth month—is not at all uncommon among the poorer classes. The ill effects upon the mother and the child are numerous, and the consequences to both are frequently very grave. These effects are more frequently seen in women of weakly or strumous constitutions whose vitality has been depressed further by the strain of pregnancy and lactation. The *symptoms* of the condition, to which has been given the name *tabes lactea*, are unmistakable. The quantity and quality of the blood are impaired; the patient is pale, emaciated, and complains of aching pain in the back and loins, and in the breast when the child is suckled. There is loss of appetite, and muscular and nervous weakness with insomnia, headache, and vertigo. In many cases, further neglected, hysteria or more serious changes in the nervous system may be followed by insanity. Cramps and contractions of various muscles, beginning with tingling, are frequently observed; even speechlessness, dysphagia, orthopnea, and attacks of syncope have been noted. Serious derangements of the eyes have also been observed as a result of the extreme reduction of the vital powers and the impoverished condition of the blood, varying from a mild conjunctivitis to ulceration of the cornea or retinitis with total loss of sight. In those predisposed to phthisis this disease frequently develops at this time. Hyperlactation, on account of the associated debility, sometimes is an etiological factor in the development or aggravation of skin affections, particularly psoriasis.

The treatment of hyperlactation is the prompt weaning of the child and

the use of tonics, nutritious food, and a temporary change in the patient's surroundings. Usually rapid improvement follows.

III. Diseases of the Non-sexual Organs.

1. Fever due to Causes other than Puerperal Infection.

While it is true that sometimes a rise of temperature in the puerperium occurs wholly independent of infection, it is also true that from a clinical standpoint the safest rule is to believe that fever occurring during the puerperal period always has an infectious origin until indubitably proven to be due to some other cause. There are, however, several conditions which not infrequently are observed to produce non-infectious fever in the puerperium. One of the most important causes of fever having a non-infectious origin in the puerpera is, for want of a better explanation, called "reflex irritation." When

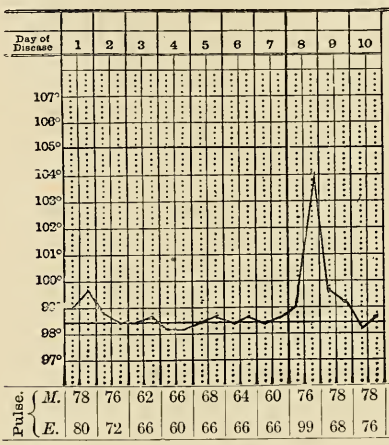

Fig. 152.—Fever following exposure to cold.

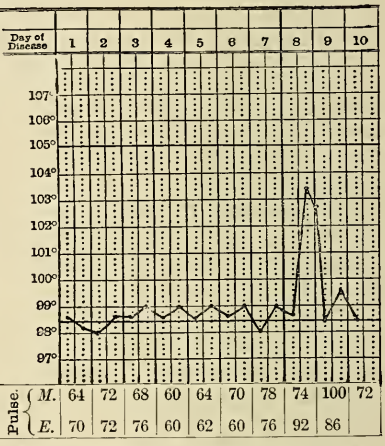

Fig. 153.—Elevation of temperature due to engorgement of the mammary glands.

it is remembered that during the puerperal period the patient's nervous system has not fairly begun to recover from the nervous irritability which was so pronounced throughout pregnancy, it is easy to understand that causes which in health would have little if any effect upon the patient's nerve-equilibrium will, out of all proportion to their magnitude, produce marked effects upon the peculiarly nervous susceptibility of the puerpera. The sudden rise in temperature so commonly observed associated with congested and engorged mammary glands (Fig. 153) or with a sore nipple is certainly in large measure due to reflex irritation, although the element of infection in some cases is partly responsible for the fever, especially if the latter continues, in which event mastitis should be suspected.

Exposure to cold, with consequent internal congestion, especially of the breasts and of the abdomen, is also a cause of transient fever in puerperal patients who have been careless about proper protection with clothing or who indiscreetly expose themselves soon after labor. The chart (Fig. 152)

illustrates such effect upon a woman who left her bed eight days after her delivery and walked through an unprotected corridor to the closet. Soon after her return she was taken with a chill and her temperature rose as indicated in the chart. After the administration of a hot punch and the protection of an extra blanket the fever disappeared.

Emotion is recognized as a cause of fever independent of the puerperium. That profound emotion markedly influences the temperature in the early puerperium is well known, but the exact mechanism of the production of fever by this cause is unknown. The appended charts are of two cases recently observed by the writer. The rapid rise of temperature observed in one (Fig. 154, A) followed the thoughtless announcement to the patient that her husband had been killed in a railroad accident. The secondary rise of temperature was due to the patient's anxiety about her inability to provide for herself and child, which anxiety was relieved by promised assistance. Figure 154, B is the chart of a patient who occupied a bed adjacent to a companion who manifested signs of mild puerperal insanity. The insane patient declared that during the

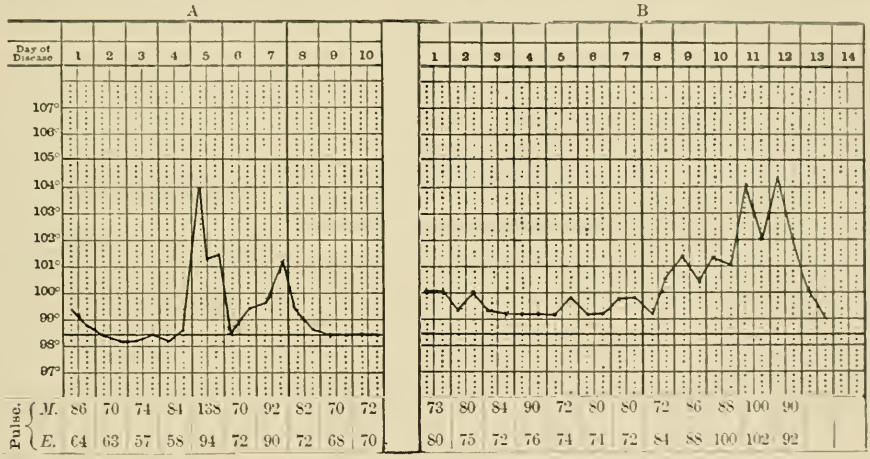

FIG. 154.—Fever due to emotion.

night her infant had been exchanged for the sane patient's child, and insisted that the latter patient should surrender her child, which the insane woman claimed as hers. The anxiety and trepidation of the patient whose chart is here exhibited was so great, and the rise of temperature was so coincident and pronounced, that the relation of cause and effect could not be mistaken. Upon removing the insane patient to another room the alarm of the anxious mother disappeared and her temperature fell at once to the normal.

Acute constipation in the puerperium is a frequent cause of fever, which is doubtless due to the irritation of retained animal alkaloids. This phenomenon is another example of the susceptibility of the nervous system to various forms of irritation that at times other than the puerperium produce little or no effect.

When a patient, before or during pregnancy, is the subject of a disease accompanied by fever, the elevation of temperature will usually be increased

during the puerperium, since an exacerbation of the disease is likely to occur. The fever-curves of phthisis, of pneumonia, of typhoid fever, and of other serious diseases are thus modified.

Very high fever is often observed when serious disturbances of the brain complicate the puerperium, such as cerebral hemorrhage or embolism or eclampsia. It is possible for a puerperal patient to be stricken with thermic fever, and the essential fever of syphilis is sometimes observed in the puerperium.

2. Intercurrent Diseases.

The puerperal patient may, of course, be attacked by any acute disease. There are, however, a few diseases which it is desirable to mention briefly, since their relation to the puerperal period is of more than ordinary importance.

Exanthemata.—In recent years the important relation of the exanthemata to puerperal infection has been better understood, and there is now little doubt that the germs of the virulent infectious diseases may effect an entrance into the puerperal patient either through their ordinary and peculiar modes of entrance, or through wounds of the genitalia, which latter channel is relatively far more frequent, more dangerous, and therefore more important. When any of the exanthematous diseases occur as complications of the puerperium without symptoms or signs of infection of the genital organs—a very infrequent occurrence—the *prognosis* is more grave and the *treatment* is the same as under other circumstances, with rigid antiseptic precautions added to prevent invasion through the parturient canal.

Scarlet Fever.—When scarlet fever is contracted by the puerperal patient the poison having been introduced through wounds in the genital canal, the clinical course of the disease is greatly modified. The incubation period is shortened to twenty-four or forty-eight hours. The *diagnosis* is usually obscured by the fact that other forms of septic infection are frequently accompanied by skin eruptions which are similar in appearance to that of scarlatina (see p. 226). This fact doubtless explains the erroneous idea, formerly so widespread, that scarlatina very frequently attacked puerperal patients,* in whom it was thought there existed a peculiar susceptibility to this disease, and for whom a previous attack in early life is said not to be protective to the same degree.

When it is known that the patient has been exposed to the germs of scarlet fever, and when the poison has entered the genital canal, the vagina may show the redness, swelling, and pseudo-diphtheritic patches ordinarily observed in the throat, and the rash may be most apparent in the region of the vulva. The later occurrence of desquamation when the patient survives will sometimes help to verify the diagnosis.

The *prognosis* is, of course, grave, being very much worse according to the extent of invasion of the pelvic or other organs. The *treatment* is that for the grave forms of puerperal infection.

Erysipelas.—The relation of erysipelas to puerperal infection is even more

* Martin found only three cases of scarlet fever in 16,000 patients in the Berlin clinics. (Spiegelberg, *Lehrbuch der Geburtshülfe*, 3d edition, 1891).

striking than that of scarlet fever. Barnes[117] has said that erysipelas "will perhaps account for more epidemics of puerperal fever than any other external poison." The channel of infection is usually the parturient canal. Of 15 cases observed by Hugenberger, eleven were of the genitalia, two of the nates, two of the face. Winckel saw 36 cases—twenty-eight of the genitalia, two of the breasts, six of the face and scalp. Of Fehling's 5 cases, three were of the face. It is doubtless true that very many cases of puerperal infection are of erysipelatous origin, which, in the absence of the usual symptoms of this disease, cannot be recognized without bacteriological examination. The disease develops more frequently in the first than in the second week after delivery, and death occurs oftener in the second than in the fourth week. The *prognosis* of facial erysipelas in the puerperium is comparatively favorable. When the disease attacks the parturient canal the mortality is high; twelve of Winckel's cases ended fatally. The *treatment* is that for grave puerperal infection.

Diphtheria.—The relation of diphtheria and of other infectious diseases to puerperal infection is similar to that of erysipelas, and the same antiseptic precautions against all infectious diseases are urgently demanded.

Pneumonia; Rheumatism.—It has been asserted that the puerperal patient is especially predisposed to pneumonia and to rheumatism. These diseases may occur as intercurrent affections, but it is a fact that a septic pneumonia or a septic arthritis, to both of which diseases reference has been made (pp. 221, 226), will account for the relative frequency of the former diseases in the puerperal period. Pneumonia, not of septic origin, occurring in the puerperal period requires no consideration in this work beyond the statement that the course of the disease is more serious than pneumonia in non-puerperal women, the fever being especially high, and the prognosis is distinctly more grave. When secondary to infection of the parturient canal, pneumonia is often of embolic origin, and is frequently observed as a complication of uterine phlebitis or phlegmasia alba dolens. The course and treatment of septic pneumonia are described in the section on *Puerperal Infection.*

A septic arthritis can be differentiated from true rheumatism by the history of the case; by the absence of acid sweats, of cardiac complications, and of marked febrile reaction; and by the fact that one of the large joints, often the knee, is affected; that other joints are very rarely affected in succession; that it has a longer duration and a tendency to ankylosis or to suppuration in the joint, with general septic infection; and that arthritis is more apt to occur in women who have had gonorrhea before labor. The cause of this so-called "puerperal rheumatism" is probably a specific variety of micro-organism having a predilection for the joints. *Treatment* consists in a careful disinfection of the parturient tract and in keeping the joint at rest, in the application of iodin or ointment of belladonna and mercury to the joint, and, after acute inflammatory symptoms subside, in the employment of cautious passive motion.

Malaria.—Malaria is one of the most important intercurrent diseases of the puerperium, not only because women recently confined have an increased liability to this disease—a fact generally admitted—but especially because this

disease so often simulates sepsis, from which it is of the utmost importance that malaria be differentiated. Clinically, women subject to the malarial poison almost always, as the result of the traumatism of labor, manifest this disease after delivery, at which time the type of malaria ordinarily is mild, but exceptionally it may be very severe. The disease usually appears on or about the third day after delivery, and often modifies the course of the puerperal period. While malaria, according to Abelin,[118] does not modify the involution of the womb, acute types of the disease, to some extent, predispose to puerperal hemorrhage and to profuse and prolonged bloody lochia.

The influence of malaria upon the milk-secretion is shown by a diminution in the amount of milk secreted, especially when the fever is highest. Whether the germs of the disease are transmitted in the milk to the nursing infant is by no means certain. In some cases it has been asserted that such transmission has been observed.

Diagnosis.—The diagnosis of malaria occurring in the puerperium is often very difficult, and, as stated above, the close resemblance of this disease to some forms of beginning sepsis renders the differential diagnosis the most important feature of malaria complicating the puerperium. A safe clinical rule is to reserve a diagnosis until the parturient tract is known to be uninfected. While frequently the date of appearance is the third day after labor, wide variations are observed. The duration and marked remissions of the fever, its frequent but not invariable periodicity, and especially a morning elevation of temperature; the character of the pulse and the more evident relation of its rapidity to the degree of fever; the blood-examination for the malarial plasmodium; the enlargement of the spleen and of the liver; the quantity and quality of the lochia; and, finally, the efficacy of quinin,—will often assist the diagnosis between malaria and puerperal sepsis.

Treatment.—An early diagnosis is usually difficult, and, in order that beginning septic infection of the parturient canal may not meanwhile gain headway, it is a safe rule to disinfect the vagina, or even the uterus, and to administer a calomel, and later a saline, purge, followed by one or two free doses of quinin (gr. x, administered morning and evening). This course of treatment may further obscure the diagnosis for a time, but it has the advantage of promptly detecting and treating beginning infection, thus avoiding delay in stopping its further progress. If the disease is malaria, the fever will likely recur, but usually it will readily be controlled by quinin, which ordinarily should be administered in daily doses of from 15 to 30 grains throughout a period of ten days or two weeks. The chart (Fig. 155) illustrates this plan of treatment. The notes of the case are as follows: Sixth day: Tongue coated, conjunctivæ yellow; uterus enlarged, reaching more than halfway to umbilicus; bloody lochia persistent and not offensive; a very large amount of healthy deciduæ and blood-clots removed with curette and placental forceps, followed by douche and gauze packing; calomel (gr. iij); quinine (gr. x), at night and on the following morning. Ninth day: Temperature again elevated; uterine involution progressing;

bloody lochia diminished; quinin, gr. x thrice daily. This dose of quinin was given until the seventeenth day, when cinchonism first appeared, and, as is shown by the chart, the fever disappeared and did not return.

The writer has repeatedly observed a fact recorded by others—namely, that some puerperal cases of malaria require exceptionally large doses of quinin.

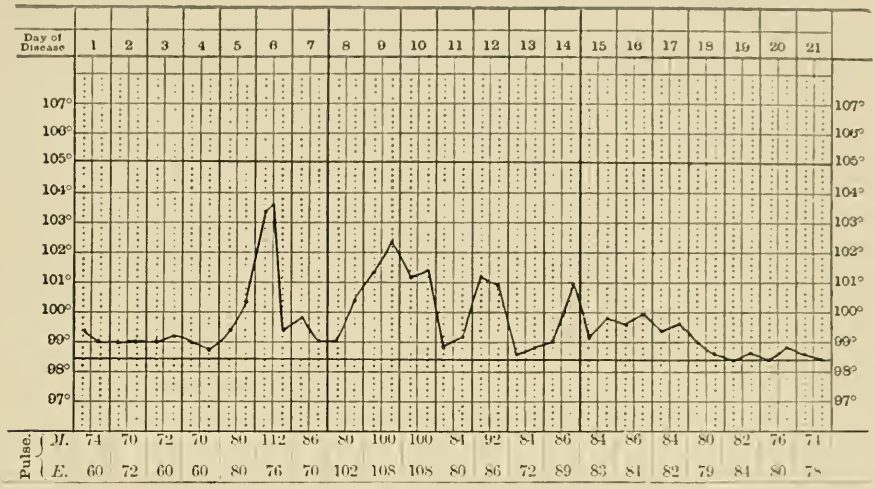

FIG. 155.—Malaria in the puerperium.

The chart (Fig. 156) illustrates this fact. In this case from the third to the tenth day a daily dose of 15 grains was given, and, the temperature having ceased to rise, the drug was about to be discontinued. Two days later—on the twelfth day—the temperature rose to 103$\frac{2}{5}$° F. notwithstanding the quinin; the daily dose was then doubled, 30 grains being given daily until the fifteenth

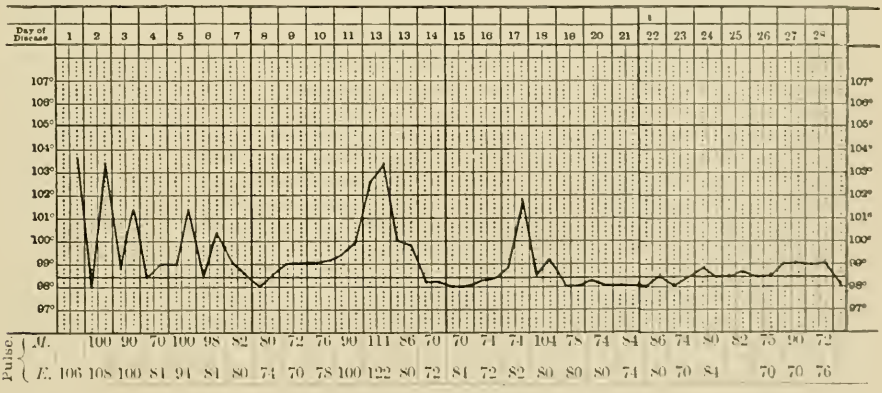

FIG. 156.—Malaria in the puerperium.

day, when the fever, apparently being controlled, the amount was reduced to 15 grains. On the seventeenth day a chill occurred and the temperature rose to 101$\frac{4}{5}$° F., whereupon 30 grains were given daily until the twenty-third day, when cinchonism occurred and the temperature became normal; the amount of the drug was then reduced to a very small daily dose.

The chart (Fig. 157) also illustrates the necessity of administering large doses of quinin in some puerperal cases of malaria. Whenever attempt was made to reduce the dose from 10 grains thrice daily the temperature invariably was elevated, and the fever was finally controlled by administering 20 grains thrice daily (20th, 21st, 22d, and 23d days).

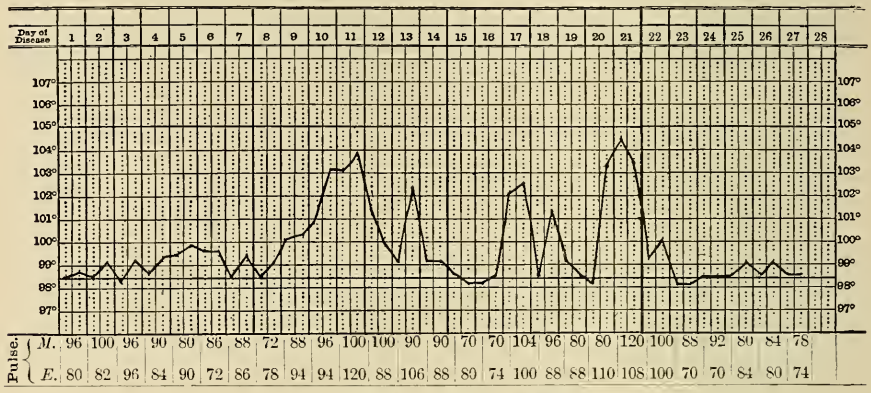

FIG. 157.—Malaria in the puerperium.

The chart (Fig. 158) exemplifies a milder type of puerperal malaria controlled by a daily dose of 6 grains of quinin.

When it is necessary to resort to large doses of quinin to control malarial fever in the puerperium, the writer's experience agrees with that of Burdel, that

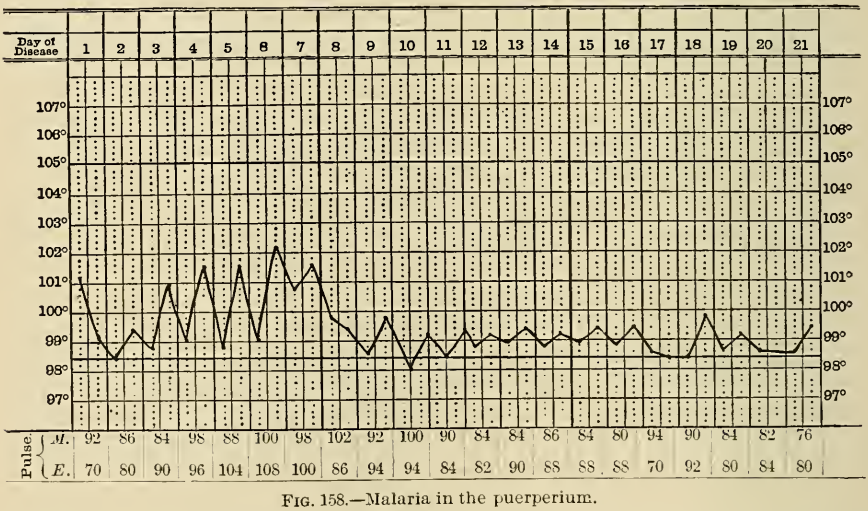

FIG. 158.—Malaria in the puerperium.

the infant is likely to suffer and should be taken from the breast. A daily dose of from 15 to 20 grains has, however, produced no apparent effect. In cases of chronic malarial cachexia with an acute exacerbation after labor, arsenic combined with quinin will often be more efficient than quinin administered alone.

Hemorrhoids.—The interference with the venous circulation of the rectum

during the last months of pregnancy very often leaves the rectal veins in a hemorrhoidal condition, which frequently occasions great discomfort during convalescence. Relief may be obtained by free action of the bowels, by the application of hot-water compresses, or, if more agreeable to the patient, by the use of an ice-bag. A piece of cotton saturated with the distilled extract of witch-hazel and inserted partially through the anus, or the use of an ointment composed of equal parts of the ointments of galls, belladonna, and stramonium, will further relieve the pain.

Puerperal Anemia.—According to the investigations of Ingersley, Fehling, and Meyer,[119] the average number of blood-corpuscles and the hemoglobin value of the blood are lessened during the first four or five days of the puerperium, but by the fifteenth day the number of corpuscles and the quantity of hemoglobin have practically returned to normal.

It very frequently happens, however, especially among the poor and ill-fed, that the physiological changes occurring in the blood during pregnancy not only fail to disappear, but even become aggravated under the strain of lactation, and a very marked anemia appears. This impoverished condition of the blood is especially liable to occur when the patient is the subject of any wasting or depressing disease, such as phthisis, chorea, insanity, or when at the time of, or subsequent to, labor hemorrhage or sepsis has occurred. The anemia in such cases may progress, if neglected, to a pernicious form. Careful blood-examinations may be made to observe the effect of treatment, which is usually efficient if not too long neglected. The administration of iron and of arsenic combined with hygienic and dietetic treatment should be kept up for a long period.

3. Diseases of the Urinary Organs.

Functional disturbances of the bladder, such as inability to urinate and urinary incontinence, are of frequent occurrence after labor, and are sometimes very troublesome affections, especially incontinence. The loss of power to evacuate the bladder may be due to the inability of the patient to empty the bladder while lying in bed, or to injury of the urethra and the anterior vaginal wall, the resulting edema diminishing the calibre of the urethra and making its course tortuous. Cases of the latter class are usually permanently relieved by a single passage of a catheter, which straightens the tortuous canal, and when infection of the urethra and bladder does not occur the swelling rapidly subsides and there is no further difficulty. The diminution of intra-abdominal pressure and the relaxed condition of the abdominal walls also prevent the operation of this pressure and the action of the abdominal walls in emptying the bladder; and, further, it is asserted that after labor the bladder-walls admit of greater distention by accumulated urine than can occur during pregnancy. The walls are thus slower to contract in response to the stimulus of the urine in the bladder, and the physiological increase in the amount of urine excreted early in the puerperium soon overdistends the organ. The dangers of over-distention are not only the imme-

diate injury to the bladder—a catarrhal cystitis—but a further and greater danger lies in the fact that the bladder-tissues are thereby rendered less capable of resisting the destructive action of micro-organisms, should the latter effect an entrance. A simple catarrhal cystitis may thus be converted into a serious infective cystitis. The means to be employed for emptying the bladder, and the necessity for chemical cleanliness of the catheter when it is used, have been referred to (p. 173).

Incontinence of urine in the puerpera is often the incontinence of retention. The continual dribbling, however, may be the result of paresis of the sphincter muscle from prolonged labor in head presentation, or it may result from fistulæ. The *treatment* will be governed by the cause. Paresis of the bladder-sphincter very often disappears spontaneously, and recovery can be hastened by the administration of tonics, especially strychnia, and by applications of electricity to the base of the bladder. If a fistula cannot be healed by stimulating applications, such as nitric acid or nitrate of silver, a plastic operation is necessary a few weeks after the patient leaves her bed.

Cystitis and Pyelitis.—The most important organic affection of the urinary organs after labor is cystitis. This disease commonly is mild and of short duration, but it may be a very grave complication when it is due to infection of the bladder. Some cases of septic cystitis assume a most malignant type.

Etiology.—A simply catarrhal cystitis is frequently observed to follow injury to the bladder, either from pressure of the child's head or from over-distention of the bladder. The symptoms in these cases usually disappear in a few days, either spontaneously or after mild treatment. The great danger of the disease is an added infection, for, as pointed out by Bumm, Dubelt, Rovsing, and others, a healthy uninjured bladder can resist the action of micro-organisms; when, on the contrary, a catarrhal cystitis is present, the subsequent introduction of micro-organisms rapidly converts the catarrhal into a suppurative inflammation, which may spread along the urinary tract and finally involve the kidneys, producing pyelitis, pyelo-nephrosis, or nephritis. Ascending infection of the urinary tract usually begins in the bladder, the infecting poison gaining access within this viscus in one of several ways. Commonly the catheter carries the infecting agent into the bladder, either itself not being chemically clean, or, if properly sterilized, but improperly introduced, it may, at the time of its introduction into the bladder, become contaminated by decomposing lochia. Escaping these dangers, there is yet another danger of carrying into the bladder, on the catheter, micro-organisms commonly found in the otherwise normal urethra. Garonsky,[120] Rovsing,[121] and others have shown from their investigations that pathogenic bacteria are commonly found in the urethra. Exceptionally infection of the bladder may occur independent of the use of the catheter. Recent clinical and experimental studies of cystitis, particularly by Doyen, Clado, Hallé, Albarran, Rovsing, Morelle, Denys, Schnitzler, and Krögius, apparently prove that micro-organisms located in any of the pelvic viscera may find their way into and infect the bladder. The observations of Reymond[122] are especially

interesting. In two cases of cystitis, where the micro-organisms in the uterus and bladder were identical, treatment of the bladder was without result, but after curetting and disinfecting the uterus the cystitis rapidly disappeared. In seven other cases a cure of long-standing cystitis followed removal of the diseased pelvic organs. His four experiments upon animals showed that the introduction of bacteria into the pelvis outside the bladder-walls gave rise to cystitis with the micro-organisms in the bladder, and not in the blood-current of the pelvis. In Wreden's[123] experiments, intestinal micro-organisms, or those intentionally placed in the bowel, were found in the bladder.

Very exceptionally the bladder may escape serious inflammation, but injury to the ureters, with subsequent infection, may be followed by inflammatory changes in the pelvis of the kidney or in the kidneys. Labor may also be followed by perinephritic abscesses due either to infection of the pelvic connective tissue, and extension of inflammation by continuity of tissue, or to infection from rupture of a kidney-abscess into the surrounding cellular and fatty tissue.

Diagnosis.—The symptoms of catarrhal cystitis in a puerpera are the ordinary symptoms of irritation and acute inflammation of the bladder. In septic cases the early symptoms are similar; later they are very violent, when exfoliation of the mucous membrane or even of the bladder-walls may occur, and occasion severe tenesmus or retention of urine by obstructing the urethra. Fever is usually moderate so long as the inflammation is confined to the bladder, and gradually disappears after from three to six days. Should this gradual defervescence be followed for ten days or two weeks by an almost afebrile curve, and should the temperature then rise rapidly to a greater height than had previously existed, and be accompanied by pain and tenderness in the region of the kidney, it may be assumed that the pelvis or the parenchyma of the kidney has been invaded. When the temperature from the beginning of cystitis is very high—above 103°—rapid infection of the kidneys has likely occurred.

Examination of the urine will also help to determine the extent of the inflammation by the presence of a large amount of albumin, of renal epithelium, and of casts; and bacteriological examination of the urine will be of further assistance in recognizing those very rare instances of infection of the urinary tract unaccompanied by purulent urine and without marked bladder symptoms.

The time required for the spread of the inflammation from the bladder or adjacent structures along the ureters to the kidneys varies. The usual time is about ten days or two weeks after the appearance of a very mild or severe cystitis. It can, however, in rare cases occur almost from the outset, before or coincident with marked bladder-symptoms and in some cases pyelitis, pyelo-nephrosis, or nephritis becomes apparent only after a long-standing and persistent cystitis or ureteritis.

Prognosis.—The danger of cystitis occurring after labor depends largely upon the promptness and the care exercised in treatment. Neglected cases with ulceration and exfoliation of the bladder will have a mortality of 38 per cent., and of those who recover greater or less permanent damage is done to the

urinary organs, from which damage the patient may ultimately die. Pyelitis persisting for months is a not uncommon sequel.

Treatment.—Prevention is of first importance. Catheterization should not be resorted to unless all other means to secure urination fail, such as repeatedly placing under the patient a bed-pan filled with hot water; the sound of running water; assisting the patient into an upright position upon her knees, and pressure over the bladder. While avoiding the catheter, however, the danger of over-distention must not be forgotten, and the catheter must be used, if other means have failed, at intervals of at least twelve hours, but always with strictest antiseptic care. At the earliest appearance of cystitis the bladder should carefully be irrigated every four hours through a two-way catheter with a ½ per cent. creolin solution, or, if this causes much pain, a solution of boric acid (gr. xv to f℥j) may be substituted. Warm applications over the bladder and diluent drinks are also to be used. Five- or ten-grain doses of salol three times a day will be of service so long as the parenchyma of the kidneys is not invaded. Urotropin in doses of 5 grains is a very useful remedy. When constant dribbling from the bladder is replaced by retention of urine, occlusion of the urethra by an exfoliated portion of the bladder should be suspected, and the separated portion should be removed, dilating the urethra for this purpose if necessary. Large doses of iron, inhalations of oxygen, and the free use of stimulants constitute the general treatment on which most reliance can be placed when the patient is profoundly septic.

The treatment of *pyelitis* following labor will depend upon the character of the disease. In mild cases it may be sufficient to obtain drainage by the administration of diuretics that act mechanically, such as large draughts of water, and to attempt disinfection of the urinary tract by the administration of salol or boric acid in doses of 5 or 10 grains every four hours. For subacute or chronic cases alterative and stimulating diuretics will be useful. Cases that do not respond promptly to these milder measures should be treated by surgical means to obtain free drainage. When a distinct collection of pus in the region of the kidney is detected by palpation, the most efficient treatment is incision in the loin and the introduction of a drainage-tube, which should be removed when disappearance of the purulent discharge and shrinkage of the cavity indicate that active inflammation has subsided. When palpation fails to detect swelling in the region of the kidney, when there is doubt as to which kidney is affected, or especially when vaginal examination finds a thickened, tender ureter, catheterization of the ureters will be useful for both diagnosis and treatment. By means of the ureteral catheter and an aspirating syringe the pus should be drawn from the pelvis of the kidney at intervals of a few days, the quantity withdrawn should be noted, and the same quantity of a weak antiseptic solution should repeatedly be forced through the catheter and withdrawn. The treatment by incision in the loin is less tedious, and does not require the special appliances and skill necessary for catheterization of the ureters; moreover, should the fever and the albuminous and puru-

lent urine be due to small multiple abscesses in the parenchyma of the kidney, the opening in the loin is more favorable for diagnosis and treatment.

Albuminuria.—Albumin is very frequently found in the urine during the first forty-eight hours of the puerperium, its occurrence at this time being considered physiological. Trautenroth [124] asserts that during labor albuminuria is the rule, its absence the exception, and that in from one-fourth to one-third of the cases casts are present. Both casts and albumin promptly disappear early in the puerperium, and their presence after the first week usually means catarrh of the urinary tract or more serious disease.

Etiology.—Various explanations have been offered for the occurrence of albuminuria at a later period of the puerperium. The most plausible theory is that in cases apparently passing through a physiological puerperal period the presence of albumin in small quantity indicates a continuation of the kidney condition which was present during the latter months of pregnancy. To those who consider the kidney of pregnancy due to the excessive amount of work thrown upon the kidneys throughout the period of gestation, the similar demands upon the excretory organs during the lying-in period readily explain the continuance of small amounts of albumin in the urine of the puerpera. The frequency of albuminuria due to a continuation of the kidney of pregnancy has frequently been demonstrated by autopsy, the kidneys presenting the same condition of anemia without inflammatory changes. Albuminuria in the puerperium is very often a concomitant symptom of infection arising from the genitalia. There may be either a simple catarrhal inflammation, or, when infection is at its height, true parenchymatous nephritis may be present, caused by the excretion of micro-organisms or their toxins, the toxins acting upon the tissue of the kidney practically as mineral poisons. In even more advanced cases of puerperal sepsis metastatic abscesses in the kidneys may occur. It has been asserted that the albuminuria increases and diminishes with the pelvic lesions of septic infection. Sirédey considers puerperal nephritis a constant complication of puerperal uterine phlebitis or lymphangitis. The author has observed nephritis with albuminuria and casts develop on the fourteenth day of the puerperium in a patient with a very virulent mammary abscess.

The prognosis of puerperal albuminuria is determined by the cause. When due to the persistence of the kidney of pregnancy, the small amount of albumin slowly but completely disappears. The symptoms of the kidney-lesion in septic cases are usually obscure, and are often overshadowed by, and disappear more slowly than, the uterine symptoms. The possibility of thus explaining the very rare occurrence of eclampsia so late as two weeks or longer after labor should not be forgotten. Whether the kidney disease persists in kidneys previously normal is also determined by the cause and by the extent of injury done to the tissues of these organs. The occurrence of albuminuritic retinitis and blindness in the puerperium would indicate an old nephritis antedating the pregnancy. It should be remembered, however, that loss of vision may occur after labor wholly independent of kidney disease. Very rarely tempo-

rary blindness may occur from vasomotor disturbance of the vessels of the retina. The loss of vision may also follow severe hemorrhage, and permanent blindness may result from septic panophthalmitis.

Hematuria.—Bloody urine is sometimes observed soon after labor. Serious contusion of the bladder during labor, either by the child's head or by forceps, will occasionally be followed by this symptom. Ordinarily the blood in the urine is due to the persistence of vesical hemorrhoids which developed during pregnancy. The differential diagnosis is made by the history. The hemorrhoidal condition, as a rule, disappears spontaneously and usually requires no treatment, although exceptionally it may be necessary to employ astringent injections into the bladder. When bloody urine from injury to the bladder is present, especial antiseptic care should be observed should the use of the catheter be required. The possibility of the occurrence of fistulæ should not be overlooked.

4. Diseases of the Nervous System.

Cerebral Hemorrhage and Embolism in the Puerperium.—Intracranial accidents so serious as hemorrhage or embolism are fortunately very rare, and often are only incidental complications of the puerperium. A woman predisposed to cerebral hemorrhage would *a priori* be more likely to be stricken with this accident either during pregnancy or at the time of labor. Throughout the period of gestation the changes in the blood, the physiological hypertrophy of the heart, and the accelerated destructive changes of any pre-existing kidney-lesion all combine to offer a favorable opportunity for cerebral apoplexy. Or, having passed through pregnancy safely, the physical strain of labor would tax to their utmost the cerebral blood-vessels. Hemiplegia after an eclamptic attack is a familiar illustration of diseased blood-vessels giving way under sudden and extraordinary pressure. In the puerperium, on the contrary, the circulation at once becomes more quiet, arterial tension decreases, and the danger of cerebral apoplexy correspondingly diminishes. This explanation of the relative frequency of apoplexy occurring during the child-bearing period is borne out by statistics.

The increased relative frequency of cerebral embolism in the puerperium is to be found in the fact that sepsis, either as endocarditis or as phlebitis, is a factor of great importance in the etiology of cerebral embolism in puerperæ.

The clinical features and prognosis of cerebral hemorrhage are in no respect different from the disease as it appears apart from child-bearing, and therefore need no further consideration here beyond the statement that a paralyzed pregnant woman can pass through her labor without her uterus sharing this loss of power.

Cerebral embolism also has the same clinical manifestations in the puerpera as in others, its symptoms depending upon the size and distribution of the vessel involved, hemiplegia, monoplegia, or aphasia developing according to the trunk or branch of the vessel receiving the embolus. It should be borne in mind that paralysis in a pregnant or puerperal patient is sometimes, although

rarely, hysterical, and a critical diagnosis should therefore always eliminate hysteria. Within a year the writer has seen a case of hysterical aphonia in a pregnant woman whose mother was similarly affected. Immediately after labor the difficulty at once disappeared. It is suggestive, as Lloyd remarks,[125] that a large proportion of reported cases of paralysis in pregnant women appear to be cases of aphasia. The diagnosis of hysterical paralysis is usually not difficult when the inconsistency of some of the physical signs and the characteristic mental and moral symptoms are recognized. Hemianesthesia, more or less involvement of the special senses, the loss of voice rather than the inability to use words properly or to comprehend them, the presence in only slight degree of exaggerated knee-jerk and contractures, the absence generally of marked involvement of the face, of ankle-clonus, and of bed-sores, will at once arouse suspicion of the hysterical origin of the disease.

Neural and Spinal Affections Following Labor.—Various forms of paralysis are sometimes observed to follow labor. Frequently a transient loss of power in one of the lower extremities either is overlooked or is attributed to rheumatism or to unimportant pressure on a nerve-trunk; the inconvenience, it is thought, will soon disappear, and no further attention or treatment is directed to a condition that is by no means trifling, and one that in some cases proves a most disastrous sequel to childbirth.

The etiology of neural affections following labor may be grouped conveniently in two general classes: (*a*) Nerve-injuries due to pressure by the child's head or by forceps; (*b*) Disease of the nerves due to septic infection.

Of the first class, there is a type of cases, due to slight injury, with only partial and temporary loss of power accompanied by some pain and discomfort, all of which symptoms disappear before the patient leaves her bed, the enforced rest of the puerperium being sufficient for nature's recuperative power to effect a complete cure. This grade of injury is of not very great clinical importance.

A very important nerve-injury following labor is one producing paralysis from traumatism of the sacral or lumbar plexus, this type of paralysis, as pointed out by Mills[126] and by Hünermann,[127] being usually peroneal, and commonly associated with severe neuritis. The great frequency of involvement of the peroneal nerve is explained by the anatomical situation of its origin. The roots of the sacral plexus lie upon a cushion of muscle, but the lumbo-sacral nerve, arising from a portion of the fourth and from the fifth lumbar nerve, soon passes over the bony pelvic wall at the linea innominata, where it is exposed to injury by the child's head entering the pelvic inlet. This lumbo-sacral nerve is mainly the root for the peroneal nerve, and clinically it has been found that the paralysis of motion due to traumatism during labor is often a loss of power of the muscles supplied by this nerve. In other words, the type of paralysis in these cases is commonly an inability to dorsal-flex the foot, extend the toes, and evert and rotate the foot outward. Sometimes there is also inability to rotate the thigh inward and draw it forward—movements controlled by the superior gluteal nerve. This additional loss of power will be understood when it is remembered that the superior gluteal nerve arises from

the posterior part of the lumbo-sacral cord, and is therefore sometimes affected coincidently with the lumbo-sacral cord or is secondarily involved by the spread of inflammation. In other cases the loss of power becomes more general, the inflammation in the nerves extending throughout the entire extremity, and even to the other limb, or along the nerve-trunks to the cord, attacking the ganglion-cells of the cord, with the development of trophic changes.

The class of cases most likely to be followed by serious nerve-injuries from pressure are usually cases of pelvic deformity, in which the injury is produced by direct pressure of the child's head. Hünermann has shown that injuries more frequently follow labor delayed by a generally-contracted pelvis. In the simple flat and flat rachitic pelves there is more space in the oblique diameters, and the nerve-trunk is thus less exposed to pressure, the prominent promontory of the sacrum giving the pelvic inlet a pronounced cordiform shape, the hollow or bay to the sides of the promontory offering greater protection to the nerve-trunks. Exceptionally these injuries may follow labor when the pelvis is normal, but the presentation is abnormal—as a face or a brow presentation—the abnormal presentation offering larger diameters and thereby increasing the area of pressure. Nerve-injuries are also sometimes to be attributed to forceps. On the one hand, failure to use the instrument in proper cases when labor has been unduly prolonged, and on the other hand pressure upon the nerve-trunks during extraction or by pendulum movement of the blades, are factors in the production of the injury to the nerve that sometimes follows a difficult forceps delivery. It is usually not easy to determine which is more to be blamed for the injury received—the child's head or the forceps. To assist in determining this question Mills[128] has called attention to an important fact—namely, that the pressure caused by forceps is more often followed by injuries of the second and third, and even lower, sacral nerves, and therefore the muscles supplied by the internal popliteal—the posterior muscles of the calf—are paralyzed, rather than the muscles supplied by the peroneal nerve.

Neuritis due to septic infection may manifest itself in protean types, just as is observed in neuritis due to any toxic agent: it may be multiple or diffused, or a single nerve may be involved; it may be partly or chiefly in the upper extremities. When the upper extremities are affected, the terminal branches of the median or ulnar nerves, or of both, are commonly involved, and both motor and sensory fibres are affected. In a case recorded by Möbius,[129] in which the neuritis attacked the legs as well as the arms, the tendon-reflexes were active, the interosseous muscles were atrophied, and both hands were the seat of a burning, pricking sensation. The cranial nerves were not affected. Fever and other signs of infection were present. Not infrequently the predisposing causes of neuritis under other circumstances, such as alcoholism, syphilis, and exhaustion, are predisposing factors in the development of septic neuritis following childbirth. The lowered vitality and the depressed nervous force of the puerpera render her nervous system an easy avenue for the inroads of sepsis.

The symptoms of septic multiple, diffused, or isolated neuritis are not dif-

ferent from the symptoms of neuritis from other causes. Pain, hyperesthesia, paresthesia, and paralysis or pseudo-paralysis are commonly present. Sometimes there is anesthesia, and often there are changes in the reflexes with cramps and contractures. Atrophies and the reactions of degeneration are occasionally present.

As a means of differentiating traumatic from septic cases it is noteworthy that the symptoms of septic cases usually appear in the first, second, or third week after labor, although they may occur earlier or later.

A form of neuritis following labor, of considerable importance and involving primarily the nerves in the pelvis, is that sometimes recognized by the gynecologist a long time, it may be, after a labor that was followed by traumatism or by mild infection. In such cases there has been left in the pelvis inflammatory exudate in which a nerve-trunk or nerve-filaments are imbedded; by reason of either the spread of infection to the nerve-sheaths or the constant pressure of the exudate and the displaced pelvic viscera more or less pelvic pain and even loss of power are produced.

Neuritis and paresis of septic origin are not infrequently associated with septic phlebitis. The intense pain and the loss of power sometimes observed to accompany and to be a sequel of phlegmasia alba dolens have been considered due to the accompanying neuritis. The occurrence of gangrene in phlegmasia has also been attributed in part to neurotrophic changes, and has been thought to be not wholly the result of an occluded circulation. Septic myelitis has been observed to complicate or follow phlegmasia and to give rise to a paraplegia. Paralysis of a greater or lesser degree following phlegmasia has been recorded by Mauriceau, Boer, Casper, and Gittermann (quoted by Winckel).

When the spinal cord is attacked by the ravages of general septic infection, the clinical and pathological evidences of the myelitis commonly show very numerous and disseminated foci of infection.

Paralysis of reflex and hysterical origin in the puerperium has been described by most authors. Barnes refers to the shock of labor, exhausting the spinal centres, as a cause of reflex paralysis, and quotes Brown-Séquard's belief that retroversion may also cause reflex paraplegia. It is probable that many of the cases thought to be reflex are in reality due to the extension of the inflammation to the cord or are to be attributed to sepsis, the toxic agent reaching the nerve-centres and nerve-tracts through the circulation.

Although hysterical paralysis may readily occur in a puerpera, the profound nerve-changes throughout pregnancy and in the puerperium being sufficient to awaken functional disturbances in individuals previously predisposed to nervous disorders, it should never be forgotten that organic disease may be present, and that a careful and scrutinizing examination may bring to light something more than hysteria.

Treatment.—Rest in bed is of the greatest importance in the treatment of neural affections following labor, when, as is frequently the case, a greater or

lesser degree of neuritis accompanies the loss of power. The pain should first be relieved by the appropriate treatment for neuritis—absolute rest, alternate hot and cold applications, ointments of mercury and atropin, the internal administration of sodium salicylate or salol; the further relief of pain by phenacetin or, if necessary, by opium. Later, the iodids, and, after the pain has been relieved entirely, active electrical treatment and massage, should be employed. Pelvic inflammation should be treated systematically over a sufficiently long period in intrapelvic cases. In all cases appropriate general treatment, including strychnia and quinin, must not be neglected.

Insanity in the Child-bearing Woman.—*Frequency.*—The statistics of asylums in which mental derangements have been classified as following reproduction show considerable variation, due to a diversity of factors, such as nationality, social condition, reliability of history, etc., that cannot be analyzed here. It is sufficient to say that in from 8 to 10 per cent. of all insane females the disease developed in the child-bearing process, and that, on an average, one woman of four hundred confined becomes insane. The disease declares itself most frequently in the puerperium, usually within the first two weeks (Esquirol 66 per cent., Toulouse 75 per cent., within the first ten days), and in many cases prodromic symptoms have been present at some time during pregnancy. Next in frequency is the period of lactation, at any time of which period insanity may appear, although it is usually manifested toward the latter half. The insanity of lactation is more common in multiparæ. The insanity of pregnancy, the least frequent of all, usually begins after the fourth month, and is of about equal frequency in multiparæ and in primiparæ.

Etiology.—It is customary to classify the causes of insanity in its relation to reproduction as predisposing and exciting, and very many conditions have been arrayed as belonging either to the one or the other class. It should be borne in mind that in each individual case many factors are indissolubly associated, the patient's mental break-down being the resultant of several complex conditions, each reacting upon and intensifying the others.

Of predisposing elements common to the three varieties of alienation under consideration, the most important is hereditary predisposition, which is found in from 25 to 30 per cent. Since this is about the proportion found in insanity generally, it is evident that heredity is not of greater importance in the puerperal forms; indeed, some statistics show it to be of less importance. Of importance also are other neuroses, such as chorea, epilepsy, and hysteria. Alcoholism and the pre-existence of insanity are also frequently predisposing factors. A woman with an unstable nervous system from any cause is handicapped in her passage through the nerve-exaltations and storms that await her throughout the course of pregnancy, labor, and lactation. Individual inhibitory power will have much to do with the final issue, and if this power is not sufficient to withstand the varied determining factors of mental disease, insanity is to be expected.

During pregnancy the most important exciting cause is probably tox-

emia, by which is meant a condition of the blood so surcharged with and changed by toxic organic principles, the result of faulty metabolism and excretion, as to render the blood incapable of proper nutrition. In the pathology of pregnancy the great importance of these changes has been insisted upon (see p. 228, Vol. I.). The effect of faulty elimination of secretions altered in quality and quantity plays an important *rôle* in the production of the unstable nervous system of pregnant women, and we are not, therefore, surprised almost invariably to find, preceding an outbreak of insanity, constipation, incapacity of the liver to perform the work thrust upon it, and failure of the skin and the kidneys, with or without albuminuria, all of which certainly can and do induce faulty nutrition of the brain. Of less importance, but contributory more especially to the insanity of pregnancy, are moral factors, such as mental anxiety from domestic worry, desertion, or seduction. The exciting causes of insanity in the puerperal period have variously been stated to be sepsis, anemia, dystocia, post-partum hemorrhage, eclampsia, great exhaustion, and profound emotion, and in individual cases one or more of these causes is usually discoverable. The employment of instruments and anesthetics during labor has not been included as a cause, for the reason that their more general employment without a proportionate increase in mental derangements, and their capacity to relieve the suffering which otherwise must react unfavorably upon the individual's nervous force, seem sufficiently plain to consider them prophylactic rather than exciting factors.

The relative importance of the causes just enumerated is difficult to determine, a study of statistics furnishing but little light on the subject. The opinions of various authors are apt to reflect the class of cases they have individually seen, and as insanity, after all, is not so very frequent, an individual's experience must be too small to warrant general conclusions. In recent years, however, the conviction has steadily been growing that sepsis bears a far more frequent and important relation to the insanity of the child-bearing woman than has hitherto been thought. This statement, if true, is of greater significance to, and calls for closer attention on the part of, obstetricians than alienists, since to the former the immediate or remote results of infection must and should always have a deeper interest. If the toxemia of pregnancy is, as it appears to be, an important element in the insanity of pregnancy, how much greater will be the tendency of an unstable nervous system to lose its equilibrium when, overtaxed by faulty excretion during pregnancy, there is encountered the additional strain of the puerperium, when the organs of excretion for a time have new demands upon them, and when opportunities for septic absorption, in size of the dose and in the virulence and intensity of the poison, are without parallel in the whole period of the reproductive function!

There are many facts to support the belief that sepsis is by far the most important cause of the puerperal forms of insanity. First, let us study the statistics of recent years. In 58 cases Holm noted severe puerperal processes in thirteen; Hansen attributed forty-two of 49 cases to infection;[130] in 40 cases

Clark observed eight with septicemia and eleven others with inflammatory disease of the uterus and appendages.[131] Hansen places the proportion of toxic cases at 86 per cent.; Idanof, at 66 per cent.; Lallier,[132] at 70 per cent. Olshausen in his classification of puerperal psychoses assigns the first place to the infectious types.[133] Menzeis remarks that most alienists allow that some puerperal cases are of septic origin, and he further says that it is strange no one has ventured to assert that all puerperal cases are due to intoxication from either bacteria or toxemic organic compounds. Rohé[134] asserted his belief that few cases of puerperal insanity occur without preceding or coincident puerperal infection.

A close analysis of the symptoms and course of the affection gives additional support to Rohé's notion. From the fifth to the tenth day—the usual time of appearance after labor—is commonly the period in which sepsis is manifested. In unquestionable septic cases the simultaneous appearance of the mental and local disorders and the aggravation of mental symptoms that may have pre-existed are surely significant. Again, the largest proportion of cases are maniacal with elevated temperature. Clark[135] says: "Rarely was a case admitted that did not exhibit uterine or allied symptoms of abnormal character, the most frequent being pain on pressure in the hypogastrium, and scanty, extremely offensive lochia." Menzeis remarks that the improvement which follows when the lochia, having ceased, return; the invariably delayed involution of the womb; the quick production of anemia and profound blood-alterations with wasting; the benefit from purges; the widespread objection to opium; and the improvement from local uterine treatment,—all testify to the septic character of the disease and point to a primary blood-condition rather than a cerebro-cortical condition. He further believes that this poisoned blood can cause, in certain individuals of low compensation, changes in the chemical constitution of cells, by which changes nerve-energy is disordered and insanity is produced, the type and result being dependent upon the products of inflammation and the degree of their absorption.

Pathological evidence is not wanting to substantiate further the septic origin of the insanity of the puerperium. As will be pointed out later, no distinctive pathological changes in the brain have yet been found to demonstrate satisfactorily the etiology of the affection; whereas, on the contrary, the pathological findings in the pelvic organs of acute cases are almost invariably those of infection, and in chronic cases the remote results of sepsis are often apparent in old inflammatory pelvic disease. Autopsy-records for which the most scrutinizing anatomical and microscopical investigations of the brain and the spinal cord have been made are frequently summarized, as in the case most minutely and carefully studied by Feist,[136] in which case the brain-examination was negative, while the spinal cord showed in the posterior columns the lesions produced in this location by toxic agents. The writer is not aware of any extensive chemical or micro-chemical investigations with the view of shedding more light on this subject, but recent advances in bacteriology warrant the belief that some

day proof will be abundant of the universal belief that either toxemia or septic infection is a primary factor in all the psychoses of childbirth.

As determining elements of lactation cases, anemia, prolonged lactation, repeated child-bearing, or other bodily conditions productive of exhaustion are most important; and among these the remote effects of sepsis also should have a place.

Pathology.—Numerous pathological changes have been found in the bodies of those dying with puerperal insanity, but, as has previously been stated, none of these changes offers a wholly satisfactory explanation for the morbid processes of the brain. Congestion of the brain and its membranes is usually found in the more active types, and in evident septic cases inflammatory changes with capillary emboli have been observed. In other cases the brain-substance has been pale, and in some chronic cases its convolutions were shrunken. The evidences of anemia throughout the body were widespread.

Symptoms.—The forms of psychical disturbance met with are mania with or without delirium, melancholia, and dementia, the latter being the final stage of cases that become chronic. Mania and melancholia are the prevailing types, mania being the most frequent type and occurring oftenest in the puerperium, and more often in lactation than in pregnancy. Melancholia is more common in pregnancy, at which period active delirium is very rare.

Insanity of Pregnancy.—In a large proportion of cases of insanity of pregnancy the alienation is of a mild type and is preceded by prodromal symptoms. The physiological changes in the nervous system characteristic of pregnancy are heightened. The alterations in disposition, the irritability of temper, the peculiar whims, and the depression are often followed by a condition of high nervous tension with loss of memory and of self-control, and after a period of insomnia the condition gradually merges through sadness, distrust, and apprehension into established melancholia. The patient becomes reserved and indisposed to mingle with her friends or her family, and is distrustful of all around her. Religious or erotic impulses may develop, and efforts at self-destruction may be made on account of an imagined unpardonable sin. This tendency to commit suicide calls for constant watchfulness. The patient may indulge in lewd and obscene language or may make improper overtures to male acquaintances. Active delirium occurs in rare cases.

Insanity of Labor.—Every obstetrician has observed the varied capacity of his patients to endure the agonies of childbirth, and there are but few who have not witnessed, in individuals practically maddened by their supreme suffering, acts of nervous exaltation, which force the conviction that for the time mental inhibition is lost and that the patient is no longer responsible for her acts. Without previous indication for the use of an anesthetic the writer has observed, as did Hervieux, a patient rise suddenly from her bed, and with wild screams attempt to jump from her bedroom window. In another case the patient's loud cries of "Help!" "Murder!" brought to hand two officers whose protection the writer was compelled to claim against the fury of an

ignorant husband. Usually and fortunately, the insanity of labor disappears after delivery. Its treatment should be the termination of labor by forceps or by version under anesthesia when labor is unduly delayed.

Insanity of the Puerperium.—When the disease develops at this time, delirium is common, particularly in the cases occurring early—before the fourteenth day. Here also there are in at least half the cases closely observed prodromal symptoms during pregnancy. These symptoms may have been overlooked, or the onset may arise with startling suddenness accompanied by suicidal or homicidal tendencies. Fever, which is commonly present, may be very high in severe septic cases. If the patient is maniacal, which is the most common type, she is sleepless and violent and attempts to destroy those around her. There are delusions and hallucinations. The ideas and language of the patient flash from her with remarkable rapidity and incessant change. Now sensuous, obscene, profane, and making attempts at self-exposure, in an instant she may revert to religious ideas, to indulge in prayer and the singing of hymns. In one case, that of an illegitimately pregnant colored girl of nineteen, the writer was thought to be the Almighty, from whom the girl piteously besought pardon for her sins. The next moment, while counting her pulse, he was turned upon with a frenzy from which he barely escaped, the patient, now terrorized by his presence, believing him to be Satan himself, upon whom she spat with fury. Within a very short time he left her singing a Sunday-school song, which was soon followed by word-pictures of obscene situations mingled with revolting profanity. Melancholia in the puerperium occurs less frequently than mania —usually after the fourteenth day—and it is very apt to be accompanied by persistent attempts at suicide, requiring unremitting watchfulness on the part of attendants. Delusions involving frequently the husband's fidelity, and hallucinations of sight and hearing, are commonly present.

Insanity of Lactation.—Mania and maniacal delirium are comparatively rare in this type of insanity. The patient is usually melancholic, quiet, listless, and depressed, with frequent delusions of persecution. In the later stages the mental faculties are at a low ebb, dementia supervenes, and the patient can with difficulty be aroused from her listless, almost lethargic, condition.

It should be borne in mind that any type of childbirth insanity may occur at any period of the child-bearing process. In the preceding description an attempt has been made to give a brief outline of the symptoms of the type most frequently met with in each period. A classification of the type independent of the periods of occurrence, very convenient and practical for closely studying the progress of symptoms in individual cases, is that made by Menzeis,[137] based upon the fact that any given case may pass through six stages—namely: (1) Prodromal disturbance; (2) early delirium; (3) melancholia; (4) stupor; (5) mania; (6) dementia.

Diagnosis.—Usually there is no difficulty in recognizing the various types of insanity in the child-bearing woman. The delirium of fever or delirium tremens complicating the puerperium might offer some difficulty at the onset of

the symptoms. In the former case it will sometimes be necessary to wait for the decline of the fever before reaching a definite conclusion, and in the latter the history will go far toward clearing away any doubt.

Prognosis.—As a general statement, it may be said that about two-thirds of all cases recover within five or six months; of the other third, from 2 to 10 per cent. die from septic infection, exhaustion, or intercurrent diseases; the rest remain permanently insane. Viewed with reference to the period of occurrence, the insanity of the puerperium, particularly the nearer to labor it occurs, shows the largest percentage of recoveries, while that of pregnancy is least favorable, excluding from the latter the very mild cases of early pregnancy in which the symptoms are merely an aggravation of the ordinarily considered physiological changes of gestation. In Menzeis' cases the recoveries were as follows: In pregnancy, 43.3 per cent.; during the puerperium, 75 per cent.; during lactation, 56.5 per cent. Melancholia is more favorable than mania in pregnancy, while the reverse is true in the puerperium.

The type of the disease, however, is of as great importance as the period of its occurrence. The life of the patient is in greater danger from mania, while her mental faculties are more likely to be disabled or permanently lost from melancholia, in which type there is also a longer duration.

Again, the older the patient, the greater the number of pregnancies, and the more depression with extreme rapidity of pulse and persistent elevation of temperature, the graver is the prognosis. Intemperance also adds a risk to the disease. In cases clearly due to infection and in those in which hereditary predisposition to nervous disease is largely absent the duration is shortest and the outcome is most favorable (Toulouse). When eclampsia bears a causal relation to the puerperal form the prognosis is distinctly more favorable, the patient recovering sooner than in any other variety (Hoppe).[138] The causes of death in fatal cases, apart from sepsis, which certainly is found in a large proportion, may be intercurrent or pre-existing disease, especially of the lungs, the kidneys, and the heart. According to Menzeis, tubercle is found in one-third of the cases, not so much arising from family predisposition as from following a traumatic pneumonia due to forced feeding and stupor.

Treatment.—It is generally agreed that practically all cases of puerperal insanity should be asylum patients; that as such even the milder cases are better cared for, and that convalescence is more rapid and complete, is the belief of most alienists. An additional reason for asylum treatment is found in the fact that even these milder forms may develop into graver ones with unexpected suddenness. When delirium and suicidal or homicidal tendencies are present there is no adequate security to the patient, her family, or her attendants outside the walls of an asylum.

Contrary to the best advice, the family and friends often insist upon keeping the patient at home, and are unwilling to be instrumental, as they say, in engrafting upon the patient's future existence the popular and unfortunate stigma that attaches to the briefest sojourn in a lunatic asylum. Therefore it has been

thought appropriate to outline briefly the indications in managing these cases. Skilled attendants with experience in caring for insane patients should always be secured. Absolute rest, quiet, and isolation must be obtained, and even members of the immediate family should not be permitted access to the patient.

As the treatment of insanity generally is largely symptomatic, so in the childbirth form measures directed to the improvement of the patient's general condition are to be employed, together with special treatment for symptoms and complications that may be present in individual cases. The general treatment is all-important. Its aim should be, first, to correct disordered states of the hepatic and gastro-intestinal functions, so commonly present, in order to ensure the proper digestion and assimilation of food. An opening enema, followed by courses of a mercurial with a subsequent saline, is generally the routine beginning in asylum practice. Proper and sufficient food, usually liquid and often predigested, together with moderate stimulation, is of paramount importance. The quantity of stimulants to be employed in individual cases is best determined by principles similar to those which govern their use in "typhoid" states. Forced feeding by the esophageal tube should be resorted to only when absolutely necessary, and it may be replaced at intervals by nutritive enemata. The almost constantly associated depraved condition of the blood clearly calls for the use of iron and arsenic, which may be given in the form of Blaud's pills and Fowler's solution. The combination of the "four chlorids" is a particularly valuable preparation. Often there must be selected preparations of iron that are least likely to disorder the gastro-intestinal secretions, such as the albuminates. Nerve-sedatives are not to be used indiscriminately. Nutrition is the indication, not sedation. Bromids are of little value except in cases in which hysteria of sthenic type is prominent. Opium in any form is generally not to be employed, especially on account of its action upon the secretions. When it is necessary to procure sleep, alcohol, chloral, or paraldehyd is preferable. To reduce high temperature, quinin and cold, the latter either as a pack or as a bath, are to be employed.

In view of the growing belief that pelvic inflammations of septic origin are of greatest importance in the etiology of the puerperal forms of the disease, a careful study of the uterus and its appendages should always be made in this class of cases, and usually local antiseptic treatment is to be employed. Clark remarks: "In no class of cases is gynecological investigation of more importance than in the study of puerperal insanity."[139] In many cases operative means will afford relief and even cure—a fact urgently insisted upon by Rohé.[140] Such radical treatment, to accomplish its best result, must not be delayed too long. That it is practically futile to remove old diseased appendages for the permanent relief of long-standing nervous affections is an axiom begotten of desperate struggle between gynecologists and alienists.

When the milk-secretion has not disappeared spontaneously, measures should at once be taken to accomplish this end, and watchful care must be exercised to prevent the occurrence of mammary abscess.

While the patient is kept in bed the great liability to the formation of bed-sores should be borne in mind, and efforts should be made to prevent their occurrence. In chronic cases, and in acute cases after the subsidence of urgent symptoms, out-door exercise in the company of a watchful attendant should be insisted upon and be graduated to the patient's strength.

Acute Tympanites.—In neurotic women enormous accumulation of flatus is sometimes observed in the puerperium. The distention of the abdomen may not only occasion great distress, but when it is accompanied by complete paralysis of the muscular coat of the bowel, with persistent vomiting and obstinate constipation, such as are seen in intestinal obstruction, there is also imminent danger to the patient's life, which danger is to be avoided by most active treatment of the condition. It should be remembered that this acute paralysis of the intestines occurs without any signs of peritonitis or other evidences of infection, the symptom apparently being due to a purely nervous influence. Large doses of strychnia administered hypodermatically are indicated, and, should the patient's distress not promptly be relieved by rectal injections of asafetida or by the introduction of a rectal tube and by the application of a firm abdominal binder from the trochanters to the ribs, the large bowel may be punctured through the abdominal wall, or the abdomen may be opened and the intestines be incised and stitched at several points.

IV. Rapid or Sudden Death in the Puerperium.

No accident can happen to a woman that carries with it so much horror as rapid or sudden death at any period of the puerperium, and no physician, however great his reputation, can escape the criticism which invariably follows even when this accident is absolutely beyond his control. He should always know the causes of rapid or sudden death in the puerperium, and by explaining the utter impossibility in most cases of foreseeing or combating the death he can partially avert unjust and unkind criticism. It is desirable in this work to omit the detailed histories of cases of sudden death that have been recorded in the literature of obstetrics, the most important causes of this accident only being here enumerated. The causes of rapid death may properly be separated from those of sudden death, since rapid death will usually be preceded by an accident or grave disease which will enable the physician to foretell the probable occurrence of death, while sudden death comes with a lightning-like stroke and without a moment's warning to a patient often previously enjoying apparent health.

The causes of *rapid death* in the puerperium may be any of the following: Accidents of labor, such as hemorrhage and shock following placenta prævia, accidental or post-partum hemorrhage, rupture or inversion of the uterus; rupture of a hematoma situated either externally on the vulva or within the pelvic cavity; rupture of peritoneal adhesions or of a broad ligament or an ovarian vein; acute purpura hæmorrhagica; cerebral embolism or apoplexy;

hemoptysis; pre-existing diseases of the respiratory or circulatory system so grave as not to withstand the strain of labor, which is followed by extreme exhaustion and rapid death.

Analyses of the recorded cases of *sudden death* include the following causes: Heart failure which has resulted from rupture of the heart due to fatty degeneration, to a patch of fibroid degeneration, to acute myocarditis. Sudden arrest of the heart's action has followed a primary thrombosis in the right side of the heart, the thrombus extending into the pulmonary artery, or more frequently the cause of death has been embolism of the pulmonary artery. Rupture of a cyst in the auricular septum of the heart, of an aneurysm, of the aorta itself, and an attack of angina pectoris have caused immediate death. Mental emotion, such as a profound impression of sorrow, of joy, of anger, of exaggerated shame, of excessive pain, or of fear, has caused sudden death by producing syncope, the heart's action being interrupted by energetic and persistent excitation of the inhibitory nerves of the heart. Sudden death has followed the entrance of air into the uterine sinuses; a fatal case has been recorded from embolus of fat from the pelvic connective tissue, and death in the puerperium has followed rupture of a gastric ulcer and of a liver-abscess. The most frequent causes of sudden death in the puerperium, arranged in the order of their relative frequency, are embolism, entrance of air into the uterine veins, and heart failure, due usually to organic disease.

Embolism and Thrombosis of the Pulmonary Artery.—Some authors—notably Playfair and Barker—insist that primary and spontaneous coagulation of the blood in the pulmonary artery occurs, and they attribute this accident in the puerperium to the excess of fibrin and water in the blood, to hemorrhage, to syncope and the diminished force of the blood-current, and to the quality of the blood changed by effete materials, by sepsis, or by blood-dyscrasia. On the contrary, other writers favor the notion that embolism usually, if not always, precedes the occurrence of thrombosis, and they support this belief by the uncertainty of the pathologist's knowledge of a primary thrombosis in the right side of the heart and in the pulmonary artery, and by the facts that in about half of the cases a peripheral thrombus has been demonstrated; that the accident commonly occurs after dislodgement of a peripheral thrombus in either a femoral, an iliac, or a uterine vein following a sudden effort, such as assuming an upright posture, laughing, straining at stool, the administration of a vaginal or an intra-uterine douche, etc., any of which efforts do not cause thrombosis, but may loosen a thrombus; and, finally, that thrombosis of the pulmonary artery should occur more frequently, since the asserted predisposing causes are so commonly observed in the puerperium. It is certainly true that in many recorded autopsies, when thrombosis has been found in the pulmonary artery a scrutinizing search for a peripheral thrombus has not been mentioned. Whenever an autopsy is made, as should always be done upon a woman dying suddenly in the puerperium with symptoms of pulmonary obstruction, a most careful search for a peripheral thrombus should never be neglected.

Prognosis and Diagnosis.—When a large-sized thrombus obstructs the pulmonary artery, death may be instantaneous, or it may be preceded by precordial oppression, great fear of impending death, extreme dyspnea, cyanosis, and a rapid loss of body-heat. The heart's action is violent; the pulse is small, rapid, and irregular. Sometimes a murmur is heard over the orifice of the pulmonary artery, and in one case the patient was able to breathe better lying prone; in another case respiration was easier in the supine posture. In other cases, if the embolus is small the onset of symptoms is not so sudden, and the symptoms are similar but not so severe, in which cases death may occur after several days, or very rarely recovery may follow. From a study of twenty-five cases Playfair concluded that when the accident occurs before the nineteenth day of the puerperium the obstruction of the pulmonary artery is most likely due to a primary thrombosis; after the nineteenth day, to embolism.

Treatment.—Little can be done for an accident so grave as obstruction of the pulmonary artery. The patient should be kept absolutely at rest, and stimulants, including the carbonate of ammonium, should be administered. Prophylaxis is of far greater value. Early exertion on the part of the puerperal patient must always be avoided, especially during and after intra-uterine manipulations, and especially when phlegmasia exists; and massage for the latter disease, as frequently advised during the stage of convalescence, must be undertaken with the greatest caution.

Entrance of Air into the Uterine Sinuses.—Although experiments upon animals have shown that the direct injection of large quantities of air into the circulation is not fatal (Hare), the clinical evidence of deaths from this cause in obstetrical and surgical practice is incontestable. Lauffs[141] collected 43 cases of death following air-embolism in the uterine veins. In seventeen cases the entrance of the air was caused by injections into the birth-canal; in eighteen the entrance of air into the uterus was spontaneous; in eight gas was formed in the uterus. Post-mortem examinations proved the presence of air in thirty-one of the 39 fatal cases. In the reported cases of sudden death from a large quantity of air entering the veins of the uterus death occurred immediately or within twenty-four hours after delivery.

Etiology.—From experiments and from observation of cases it is believed that air very rarely enters spontaneously into the veins of the uterus, and that to cause speedy death the quantity of air must be considerable and the air must enter the circulation with force, as may happen during uterine contraction when the air has entered and the cervix is obstructed by the placenta or by a clot. The entrance of air into the uterus is effected during intra-uterine manipulations, such as the introduction of the hand; the giving of an intra-uterine douche; by aspiration following a change in the posture of the patient. It has been asserted that air may be aspirated into the uterus by the movements of ordinary respiration (Amussat), or that its presence in the uterus may be due to decomposition (Churchill) or to alternate contractions and relaxations of the uterus following delivery (Simpson). Winckel[142] mentions a case of air-embolism and sudden death due to carcinoma complicating labor.

Symptoms.—There may be difficulty in breathing and a temporary loss of consciousness when the quantity of air entering the veins is small; when a large amount rapidly enters the veins, respiration and circulation are immediately and desperately embarrassed; the patient may utter a cry of alarm, and at once becomes unconscious with or without convulsions. The cause of death is probably mechanical interference with the circulation.

Treatment.—Very little can be done for the patient even when assistance is close at hand. The cervix should be cleared of clots; artificial respiration and the hypodermatic administration of stimulants should promptly be employed. Tracheotomy and the inhalation of oxygen gas in order to inflate the lungs and to expel the air-emboli have been suggested.

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V. THE NEW-BORN INFANT.

I. PHYSIOLOGY OF THE NEW-BORN INFANT.

The physiology of the new-born infant differs in many essential respects from that of the adult. A better understanding of these differences than we now possess would no doubt aid us greatly in the proper interpretation of the signs of approaching and of existing disease, as well as in the management and treatment of the disorders of infancy. In the present article only those physiological differences between the new-born and the adult will be considered that are of special importance.

Growth: *Weight.*—The new-born child weighs, upon the average, seven pounds (3483 grams), boys weighing, as a rule, about half a pound more than girls. A considerably less weight than this is frequently observed in perfectly sound, well-developed babies, particularly in the case of twins, while ten- and twelve-pound babies are not uncommon. Those weighing over twelve pounds are occasionally seen, and if published records are to be trusted children have been born weighing as much as twenty-four pounds. It has been shown that the weight of the child is greatly influenced by—1, the length of gestation and the nourishment of the fetus; 2, the age of the mother (very young mothers giving birth, as a rule, to small babies); 3, the size of the mother (the weight of the child being 5.23 per cent. of that of the mother); 4, the number of previous pregnancies (the weight often progressively increasing up to the fourth or fifth pregnancy); and 5, the influence of race and climate. For two or three days after birth there is usually a loss in weight of from three to six ounces, which loss is probably due to an absence of nutritive material from the maternal mammary secretion during this time, as well as to the increased tissue-change consequent upon the circulatory changes and upon the establishment of respiration. The loss is greater in small than in large children, and they do not so quickly recover. After the establishment of the flow of milk the child begins to gain, and usually by the end of the first week it weighs about as much as it did at birth. The gain is somewhat slower in those babies fed on artificial food or even upon cow's milk. The increase after the first week varies considerably, and it is dependent upon a number of conditions, such as sex, race, nutrition, etc. The increase may be very irregular, an interval in which there may be neither loss nor gain following or preceding a quite rapid increase in weight. Approximately, however, it has been computed that an average-sized healthy child will gain about .78 ounces daily for the first three months, .63 ounces daily for the second three months, .45 ounces daily for the third three months, and .30 ounces daily for the fourth three months. The total weight would therefore be, at the end

of three months, ten pounds; at the end of six months, from thirteen to fourteen pounds; at nine months, from sixteen to seventeen pounds; and at twelve months from nineteen to twenty pounds, the increase in weight being doubled in the first six months and trebled in the second six months.

Length.—At birth the average healthy child measures between nineteen and twenty inches (50 cm.) in length, the male being slightly longer than the female. By the end of the first month the child will show a length of $22\frac{1}{2}$ inches; at the third month, $25\frac{1}{2}$ inches; at the sixth month, $28\frac{1}{2}$ inches; at the tenth month, $31\frac{1}{2}$ inches; at the fifteenth month, $34\frac{1}{2}$ inches, etc., thus showing an increase in length of 3 inches during these periods. During the first year there is generally a gain in length of from 6 to 10 inches. There may at times be a rapid increase in weight with no increase in length, and at other times an increase in length with no corresponding gain in weight. In making accurate observations the growth in weight and in length should be compared and due allowance be made for the passage of feces and urine.

Size and Growth of the Head, Thorax, etc.—The occipito-frontal circumference of the head of an average-sized new-born infant is about $13\frac{3}{4}$ inches for males and $13\frac{1}{4}$ inches for females (34.5 cm.). At the end of twenty-one months the circumference has increased to about $19\frac{3}{4}$ inches. The anterior fontanelle continues to increase in size until the ninth month; then it gradually closes, finally becoming completely closed in, ossification taking place from the borders in from sixteen to eighteen months.

The average circumference of the chest at birth is about $12\frac{1}{4}$ inches; this increases to $16\frac{1}{2}$ inches in twenty-one months. The rate of chest-growth is more rapid than that of the head. The body is proportionately wider in the infant than in the adult. The antero-posterior measurements of the head and the pelvis are the same at birth in males and females.

Respiration.—In response to stimulation of the respiratory centres the child immediately after birth, sometimes before and sometimes after the cessation of pulsation in the cord, makes its first inspiratory effort. After one or more such efforts many of the collapsed vesicles are distended and filled with air. Generally the complete unfolding of the alveoli does not take place until the second day. This first inspiration is followed immediately by expiration, and the mechanism of pulmonary respiration is established. The new-born child breathes about forty times a minute. Its respirations are, however, irregular, and they may be influenced considerably by slight causes; for instance, there may be a suspension for comparatively long intervals by attention, by muscular effort of various kinds, by fright, etc. Respiration is most regular during sleep, and this is the only time in which it may accurately be observed. A much larger percentage of the respired air is exchanged in infancy than in adult life, the amount being one-fourth in the former to one-tenth in the latter. The exchange is generally feeble at first, being a third more at the end of the first week than on the first day. In respiration the thorax is elevated progressively from above downward, the work being done largely by the diaphragm.

Circulatory System.—With the first inspiration of the new-born child there is a complete alteration of the circulation of the blood. The pulmonary arteries, until now containing only sufficient blood to supply the pulmonary nutrient vessels, become fully distended with blood to be carried to the lungs for aëration. The flow of blood being diverted from the ductus arteriosus to the pulmonary arteries, largely by the enlargement of the thorax in the first act of inspiration, the duct partially collapses, thrombi form within it, and it rapidly becomes obliterated. When the umbilical cord is tied or the circulation through it ceases spontaneously, the umbilical arteries and vein and the ductus venosus become at once greatly reduced in size, fill with thrombi, and finally become converted into fibrous cords. The foramen ovale is more gradually closed, the edge of the Eustachian valve remaining free for some time, but at the same time affording complete protection to the foramen.

Owing to the more rapid growth of the upper part of the body and to the proportionately large amount of work thrown upon the lungs, the carotid, subclavian, and pulmonary arteries are comparatively large. At the same time the heart is small, so that the systemic blood-pressure in the new-born is low. The pulmonary artery is much wider than the aorta in infancy—more so than in later life—so that the pulmonary blood-pressure is greater in the infant's than in the adult's lungs. The size of the heart is to the width of the ascending aorta as 25 : 20 in the new-born; in the adult, 290 : 61. The systemic blood-pressure is raised as the heart increases in size and the aorta becomes relatively smaller.

The blood of the new-born is comparatively less in amount than that in the adult, but after a few months the proportion of blood to body-weight is more than in the adult, but with a low specific gravity (1045–1049). At birth the amount of hemoglobin is large (22 per cent.), but the amount of fibrin is small. The hemoglobin begins at once to diminish in amount, reaching its minimum at the sixth month. The fibrin rapidly increases in amount. The infant's blood contains more white corpuscles than does that of the adult, less salts, and less soluble albumin.

The pulse for a few weeks after birth is very feeble and rapid, and it is easily disturbed and accelerated by slight causes. During sleep in the first week it averages about 120 beats to the minute; while awake, 126; and under excitement, 148 to 150. Later the number of pulsations diminish during sleep, while the number under excitement increase. Posture has but little effect upon the frequency of the pulse.

Digestive System.—Saliva is secreted immediately after birth, but in very small quantities and of weak diastatic action. The salivary glands are poorly developed, and for a few weeks at least the saliva is furnished almost wholly by the parotid gland. After two months the amount secreted is considerably increased, and it shows much greater diastatic power. At eleven months the diastatic power of the salivary secretion is nearly equal to that of the adult.

The stomach is relatively smaller, more cylindrical, and more vertically

situated than in the adult, and its muscular structure is poorly developed. At birth the capacity of the stomach is about one ounce, and there is an increase of one ounce per month up to the sixth month, after which the increase is not so rapid. The healthy stomach contains saliva, mucus, hematin, and blood-corpuscles. During the first two months of life the normal acid for the stomach is hydrochloric acid. The quantity of food in the stomach diminishes rapidly during the first hour, and in from two to two and a half hours the balance entirely disappears. The contents of the stomach are not so decidedly acid as in that of adults. Albumin is seldom found in the stomach, and only during the first hour of digestion. Water assists in the digestion of casein.

The pancreas remains in an undeveloped condition for five or six months after birth, and the action, therefore, of its secretion is very feeble indeed. *The liver* is of very large relative size at birth, occupying more than half of the entire abdominal cavity. *Bile*, light brown in color, is secreted early, and gives to the feces their orange-yellow color.

The small intestine is comparatively long, being at birth about 9 feet 5 inches in length, and it grows at the rate of 2 feet per month for two months. The intestinal villi are numerous, are as large as those in adults, and are supplied with very large capillaries, through which absorption is quite rapid. The glands of Lieberkühn and Peyer's glands are few in number and are poorly developed. There is a very copious secretion of mucus, which readily undergoes acid fermentation, especially in the presence of particles of undigested food, the feebly alkaline secretions of the liver, pancreas, and intestines being easily neutralized.

The large intestine is also of relatively great length, measuring 1 foot 10 inches at birth. The ascending and transverse colons are short compared with the descending colon, especially the sigmoid flexure. This structure is bent upon itself from one to three times, and it is the cause of congenital constipation. Later readjustment takes place, the ascending and transverse portions increasing in length at the expense of the descending colon.

The feces of the new-born consist, during the first two or three days, of *meconium*. The meconium, which has been accumulating in the intestines during fetal life, is a thick, tarry, greenish-black substance resembling thick poppy-juice. It consists of bile and mucus, together with epithelial cells, fine hairs, and fat-globules from swallowed amniotic fluid. On the third or the fourth day the feces consist of a mixture of meconium and digested milk. After the fourth day the feces are light orange-yellow in color and they consist of the residue of digested milk. They are passed from two to four times a day.

Urinary System.—At birth the kidneys are lobulated, fully developed, and functionally active, the secretion of urine taking place before birth. A gradual change takes place in the form of the kidney, so that in about two years it loses its lobulated form and resembles the adult kidney, being relatively somewhat larger.

The Skin.—Owing to more or less obstruction of the fetal circulation

during delivery the child's skin is at first of a livid hue. Upon the establishment of respiration this hue is changed to a deep red, due to the irritant action of the air. In a few days the color is changed from red to a yellowish or icteric tint, which is said to be caused by the deposit of blood-pigment during the preceding congested condition of the skin. The yellowish color gradually fades, the skin becomes paler, and finally, within three weeks, the normal rosy tint is established. More or less desquamation takes place during this time as a result of the early congestion.

The sudoriparous glands, on the one hand, are almost if not quite inactive at birth; the *sebaceous* glands, on the other hand, are very active during fetal life and up to the end of the first year. The body of the infant at birth is covered with the vernix caseosa, which is composed of the secretion from the sebaceous glands. The hair of the scalp is strong and from 1 to 2 inches long; it falls out later, and is replaced by hair finer in texture and generally lighter in color. The short, fine, downy hair with which the whole body is covered at birth drops out in about three weeks, and is not replaced.

Lymphatic System.—The lymphatic system is relatively better developed and more active, and the glands larger and more numerous, at birth than in adult life. The relation between the lymphatics and the other tissues and organs of the body is very close, and absorption is very rapid.

The temperature falls directly after birth, but by the end of the second day it rises to the maximum again (97.5° to 98° F.), where it remains stationary.

Fat is generally absent from the interior of the body, but it is abundantly present in the subcutaneous tissues.

The muscles at birth are small and soft, but they become better developed, firmer, and more resisting by the sixth month. They contain more water and less myosin than do the muscles of adults, and more extractive matters, fats, and inorganic constituents.

The bones are less brittle than later in life, containing a large percentage of organic matter.

The Nervous System.—The rate and degree of development of the nervous system and of its various functions are largely influenced by heredity, environment, and by the health of the child. The faculties and senses are more or less dependent upon each other for their perfect development, as is so clearly shown in the slow, tardy, and incomplete development of the mental faculties when hearing is absent or defective, and in the non-appearance of articulate speech when the sense of hearing is absent.

Not until the first month after birth does the gray matter appear on the brain convolutions; before this the cerebrum is soft and of a uniform color. The medulla and cord-centres are much better developed at birth than those of the brain, and they remain more active throughout infancy. The motor centres in the anterior cornua are more highly developed than are the sensory centres in the posterior portions of the cord. The extreme reflex excitability in the new-born is thus a physiological process.

Special Senses.—The special senses all respond to stimuli at birth or shortly after, but to a limited extent, and to bring out these reflexes to any marked degree the stimuli must be more intense or must be applied over a larger area than is required later.

The sense of smell responds to strong stimuli very soon after birth, and the ability to distinguish between agreeable and disagreeable odors is acquired early.

Taste exists even at an earlier period than does smell, and the response to sweet and bitter substances is different immediately after birth, the child being soon able to judge between the different forms of food offered.

Hearing is very imperfect at first, and at least several hours elapse before even very loud or sharp noises are capable of exciting responsive movements. The horizontal position of the tympanum, the as yet closed Eustachian tube, and the absence of air in the middle ear are offered as reasons for the imperfection of this sense. In two or three months the infant is able to determine from which direction a sound comes. The proper development of the mental faculties depends more upon the sense of hearing than upon any of the other special senses.

Sight is only developed at birth to the extent of a feeble response to very strong lights. Up to the sixth week there is inability at co-ordination of the ocular muscles. After this time the eyes begin to move in an orderly manner, and they will follow a bright object moved slowly in front of them. At about the second month rapid movements are perceived, as is evidenced by the child closing its eyes quickly on an object suddenly approaching it. At three months the development of sight goes on more rapidly and the child begins to separate colors. The first colors recognized are yellow, red, pure white, gray, and black. The recognition of green and blue comes later. The faculty of distinguishing between the various colors, however, is not perfected until after the third year. The estimation of size and distance is gradually developed after the sixth month. The mother is recognized about the third month.

The sense of feeling or *touch* reacts very feebly to stimuli, owing to the imperfect development of the brain and the skin, unless applied over a relatively large area. Pleasurable sensations existing during the first three months are those created by the taking of food when hungry, the act of sucking, the sweet taste of the milk, and the staying of hunger, each being in itself a pleasurable sensation. A little later the healthy babe who is not hungry enjoys the warm bath, the stimulation of attention by bright objects, and in having its limbs unconfined by clothing. The developing ability for grasping after three months gives the infant additional pleasure.

Muscular action in the new-born is entirely involuntary, there being no voluntary act until about the end of the third month. Sucking and licking are not dependent entirely upon reflex action, but are largely instinctive. The stretching and bending of the extremities are impulsive acts, and occur during sleep, as they did during intra-uterine life. Straightening of the legs

after awaking is noticed during the second week. Vocal sounds are also impulsive. Reflex movements are not so strongly marked at birth as they are a little later on. These involuntary movements are purposeless and show lack of co-ordination. The act of raising the head, which is attempted toward the fourth month in healthy children, is volitional, requiring not so much added strength of muscle as power of co-ordination. As volition develops the power of co-ordination gradually increases, and the child learns to perform voluntary or purposeful acts. Voluntary grasping is done after the fourth month. As the child learns to balance its head it attempts to sit up. This act is not successfully accomplished until about the fortieth week; the child sits firmly alone when ten or eleven months old. Those children that creep do so at about the ninth month. Standing, which is attempted at about the ninth month, is usually successful at the end of the first year or a little earlier. Some children walk as early as the eighth month, many by the twelfth month, while some do not walk until much later. Most children will walk alone by the sixteenth month.

Speech is very gradually developed, distinct words not being uttered much before the end of the first year, often considerably later. The use of vowels and of inarticulate sounds, together with gestures, answer the child's purpose of making its wishes known. As the will develops and the power of mimicry is established vocal sounds and gestures become more and more intelligible, and finally articulate words are added. Single words are used for some time to express several ideas, then two words are put together, and finally short sentences are formed.

II. PATHOLOGY OF THE NEW-BORN INFANT.

1. Medical and Surgical Diseases Incident to the Birth of the Child.

Asphyxia of the New-born.—The respiration of a child immediately after birth is usually somewhat irregular, but it soon becomes rhythmic, and within a short time inspiration and expiration take place in a normal manner. Any deviations from this, as indicated by slight difficulty in breathing on account of a large amount of mucus in the trachea or the bronchial tubes, to absolute apnea, in which there is no attempt on the part of the child to respire, represent the different grades of what is called "asphyxia of the new-born."

The phenomenon described is entirely due to imperfect aëration of the blood. It is because there has not been proper interchange of oxygen and carbonic acid gas in the blood of the new-born—a condition which may arise from causes that have been operating for some time in the uterus or on account of some delay or unavoidable process in the birth of the child. It is hardly necessary to speak of the physiology of the circulation in the placenta, that wonderful and perfect arrangement by which oxygen is received by the fetus and carbonic acid is thrown off by the mother.

The general subject of asphyxia of the new-born may be divided into two subdivisions: first, *intra-uterine asphyxia;* second, *extra-uterine asphyxia*, or that form which presents itself immediately or a short time after birth.

Three divisions or three different grades of asphyxia of the new-born will be made, and they will be named in the order of their severity: *First*, slight difficulty in breathing from the collection of mucus or any foreign substance in any part of the respiratory appartus; *secondly*, an asphyxia which is present in the child, who when born is strong and robust and full-blooded; *thirdly*, a child born asphyxiated, pale, limp, and apparently lifeless. The second and third classifications have by some of the older authors been spoken of respectively as "sthenic" and "asthenic," or the apoplectic and anemic varieties. The first class is quite insignificant, and usually respiration is established without any treatment whatever. The exposure to the irritation of the atmosphere or occasionally a smart slap on the buttocks is all that is needed in the simple variety. The other two classes, which are exceedingly important, and many times very dangerous, will now be considered in their proper order.

Intra-uterine Asphyxia.—*Etiology.*—The causes of the intra-uterine form of asphyxia arise from two sources—those originating from the mother and those originating from the fetus. The causes present in the mother that may produce this dangerous difficulty in her child are mainly disturbances of placental circulation, either from peculiarity of pain or from diseases which lead to a small supply of oxygen to her child. The causes which originate in the fetus are interferences with the cord and the placenta, pressure upon the head, and a natural or an acquired feebleness which may be produced because the parents are either immature or aged, or because the delivery is premature.

The pathological changes in intra-uterine asphyxia are about the same as those that follow when suffocation takes place from other causes. The blood is thin, the sinuses of the brain are filled with blood, with some edema of the membranes, and extravasations and slight ecchymoses are found in different parts of the several organs. The lungs are dark in color, are somewhat more firm than usual, and appear to be filled with blood. The air-passages are quite uniformly filled with mucus, meconium, and amniotic fluid. This condition suggests the question which is frequently asked as to whether the child inspires *in utero*. In some obstetrical operations, or when the hand is introduced into the uterus to perform version, air enters the cavity and produces its reflex irritation, and the child makes an effort to inspire, and in this manner draws meconium and amniotic fluid into its respiratory passages.

Symptoms of the intra-uterine form of asphyxia, of course, are difficult to be observed, and they can be determined only by very close observation of the child *in utero*. A very slow or a very rapid pulse, a symptom to which we attach the greatest importance, intimates either pneumogastric irritation or paralysis Then follows increased intestinal peristalsis, and finally muscular spasm, to which, it appears to the writer, should be added unusual movements of the child. In all prolonged labors and before prolonged obstetrical operations it is always well to examine carefully the heart-beat of the child,

because in cases of asphyxia it is important to know whether any symptoms existed previous to the birth of a child, or whether the condition obtained is the result of its passage through the parturient canal.

Diagnosis.—It will be from such examinations as above suggested that we shall be able to anticipate danger to the child, so that in all tedious and particularly difficult labors these observations should be instituted. If the heart-beat is either unusually slow or fast, we should conclude that there is commencing danger to the child. The appearance of meconium, it seems to the writer, has been over-estimated, as in a number of cases he has seen this discharge before the delivery of the child, and yet there has been born a perfectly healthy and non-asphyxiated child. In breech labors it is certainly not to be regarded as a sign of threatened asphxyia. Any unusual hemorrhage before birth, indicating partial detachment of the placenta, is a very significant symptom and deserves earnest attention.

Prognosis.—The prognosis will also depend upon the condition of the child and the possibilities of an easy and rapid delivery.

Treatment.—In threatened asphyxia of the child the indication is to deliver with all possible rapidity consistent with the safety of the mother.

Extra-uterine Asphyxia.—*Etiology.*—In a vast majority of cases of extra-uterine asphyxia there is no interference with the placental circulation; the watchfulness with which the child *in utero* has been observed has revealed nothing, yet upon the birth of the child breathing does not take place. Asphyxia has developed from causes operative while the child is passing through the parturient canal or from diseases which interfere with the original process of respiration. These causes are malformations of the respiratory or circulatory organs, intra-uterine disease of the fetus, or premature birth. Among the diseases which operate more frequently in the production of extra-uterine asphyxia may be mentioned particularly the diseases of the lungs, such as atelectasis, pneumonia, syphilitic diseases of the lungs, large pleural exudates, compression of the air-passages by large glands, and injuries to the respiratory centres from difficult labors.

Pathology.—External marks and conditions that have operated to produce asphyxia will readily be seen. The head also shows signs of compression and perhaps unnatural moulding. The lungs are frequently not fully expanded; indeed, in some instances large areas are found in the condition known as *atelectasis.*

Symptoms.—When a child is born naturally it begins to breathe, and usually to cry quite lustily. It opens its eyes, makes a face as if disgusted with the surroundings, moves its extremities, and the integument assumes a rosy hue. A child born asphyxiated presents one of two conditions altogether different from those above described. The child is either large and robust, the skin is of a livid color, and without doubt it is a strong child (sthenic), or it it is pale, wan, and anemic (asthenic). There is but little if any attempt at respiration. To all intents and purposes the child is dead. In many cases there is no heart-beat perceptible. In the first grade the child is deeply cya-

nosed; the cord is pulsating violently; the reflexes are not wholly abolished. In the second, an advanced stage of asphyxia, the pulsation may not be distinguishable; the surface of the body is extremely pallid; the extremities are motionless; reflexes and muscular tone are absent.

Diagnosis.—It is of great importance to know whether the asphyxia took place from causes intra-uterine or later, and it is also important to know which of the two forms of asphyxia, the mild or the grave, is present in each individual case. If very great pressure has been made upon the head of the child, either because the labor has been long and tedious or because instruments have been used for a long time, or if a visible hemorrhage is present, the asphyxia is in all probability due to causes operating during the passage through the parturient canal. Observations which have been made during labor, then, are very important in determining the probable cause of asphyxia. If, however, we know that there has been partial separation of the placenta before birth, and if we find the air-passages of the child filled with inspired foreign material, the asphyxiated condition of the child is in all probability due to intra-uterine causes.

Prognosis.—In the first form—that is, where the child is strong and the muscular tone and nervous irritability are not lost—if there are no other complications, the prognosis is generally good. In the second form it is always doubtful. If pressure on the head has been long and severe, and hemorrhage takes place at the base of the brain, the prognosis is bad. If the hemorrhage takes place on the convexity of the brain, the child may live longer, but the mental condition is usually bad.

How to Determine the Grade of Asphyxia.—The grade of asphyxia can be determined by irritation of the palate. If upon the introduction of the finger to remove the mucus there are choking and convulsive movements, and consequently attempts to breathe, and the presence of the reflexes is shown, it is asphyxia of the first grade, and the prognosis is good. If this irritation of the palate produces no action, but the palate remains soft, then the asphyxia is of the second grade, and the prognosis is bad.

Treatment.—In every case of labor where it is known to be serious or tedious, preparations for the reception of an asphyxiated child should be made before its birth. A table should be placed in the lying-in chamber, and upon it a pillow and a waterproof sheet should be in readiness; hot and cold water in proper receptacles should be at hand, and also a soft catheter or some other appliance for the withdrawal of mucus and other substances from the respiratory passages; an electric battery may be of use.

Treatment of the First Grade of Asphyxia.—The chief indications in the treatment of the first grade of asphyxia are—remove all obstruction from the air-passages, and by the application of reflex stimuli excite respiratory efforts. Remove mucus from the throat and mouth of the child; irritate the skin by slapping the buttocks and rubbing; pass before the respiratory organs some of the diffusive stimulants, such as camphor or preparations of ammonia. To remove foreign material from the trachea and the bronchial tubes grasp the

child by its feet, the head hanging downward; pass the little finger into the throat and wipe out the mucus. Care should be taken not to produce traumatism in the post-pharyngeal space, and so open an entrance for infection. Further to remove the mucus from the trachea, press upon the trachea with the finger as low down as the bifurcation, and gently squeeze the trachea toward the larynx. This forces the mucus into the back part of the pharynx or post-nasal space, and it can now be forced through the nose of the child by blowing into its mouth; the obstetrician should protect his mouth with a hand-

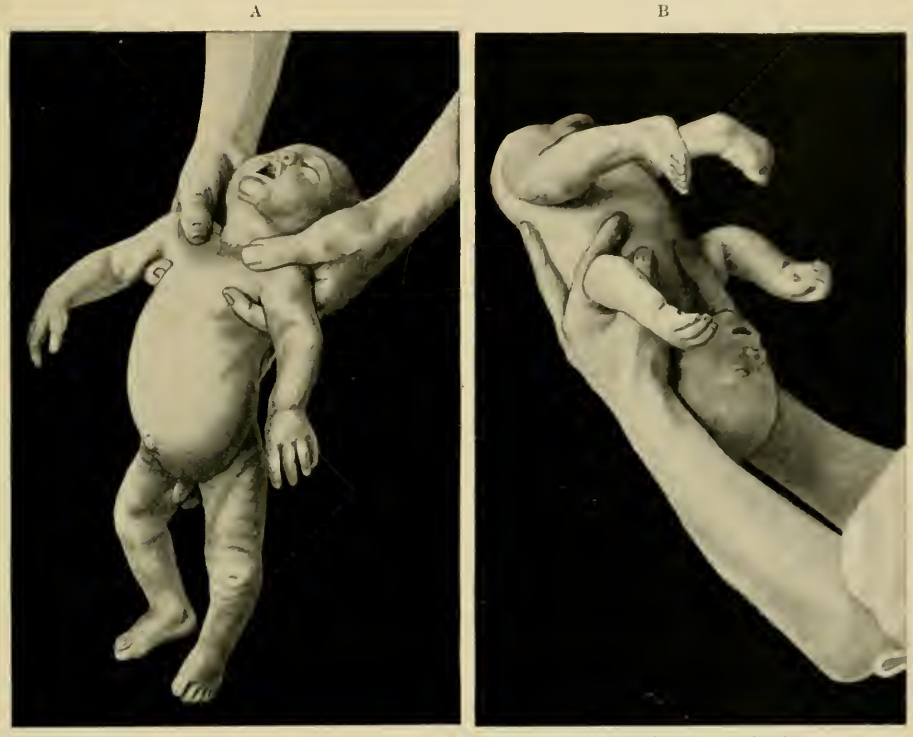


FIG. 159.—Schultze's method of artificial respiration: A, inspiration; B, expiration.

kerchief. If now the child does not begin to breathe, give it a warm bath or possibly alternate between a warm and a cool bath. Repeat all these measures, and watch the child carefully until respiration is fully and perfectly established.

Treatment of the Second Grade of Asphyxia.—If it is found by irritation of the throat that the reflexes are absent and that the child is in this severe and dangerous form of asphyxia, our treatment must be more heroic from the first. Of course the air-passages should be cleared of mucus. It is useless, however, with a child in this grade of asphyxia to attempt to make it breathe by irritation of the skin, and, while many of the procedures suggested in the first grade may be used, artificial respiration, by means of which air may be forced into the chest, must very soon be resorted to; while the method of Marshal Hall or of Sylvester may be used, the proceeding as laid down by Schultze,

and briefly described below, has generally been considered to give the best results (Fig. 159). The method, however, is not free from dangers to the child. Traumatism of the lungs, of the spinal cord, and of the abdominal viscera are not uncommon, and have sometimes caused the death of the infant after the respiratory failure has been overcome.

The physician seizes the child's shoulders by putting an index finger in the axillary space and his thumbs so curved forward and over the shoulders as to strike the end of the finger, so that the entire weight of the child's body is resting upon or within the circles made by the thumb and the first finger of each hand. While the child's body is hanging perpendicularly the ribs are being lifted out, the chest is expanded, and mechanical inspiration is produced. To produce, now, a mechanical expiration, the body of the child is swung forward with some little force at arm's length until the operator's arms are a little above a horizontal line. A somewhat abrupt termination of this motion causes the thorax of the child to become stationary, while the lower limbs topple over upward and forward upon the child's abdomen. The abdominal viscera, in the position in which the chest is at this moment, press against the diaphragm and produce expiration. The child's body is now returned to its orignal position by nearly reverse motions; the entire maneuvre occupies from seven to eight seconds and is repeated eight or ten times each minute. After practising this method for two or three minutes it is desirable to place the child in a warm bath to restore the body-heat lost during the swinging movements.

Mouth-to-mouth insufflation is a most valuable method to secure the entrance of air into the child's lungs. A towel is placed over the child's mouth, and the operator, after taking a deep inspiration, quickly but gently blows into the mouth of the child, and then gently compresses its chest. In this manner the child's lungs should alternately be inflated and emptied ten or fifteen times a minute. To prevent injury to the air-vesicles the lungs should be inflated gently, and the nasal passages should not, as sometimes advised, be closed by pressure with the fingers. Sometimes insufflation through a catheter passed into the larynx is of service. Laborde's method, which consists in the rhythmic traction of the tongue by two fingers or a delicate forceps covered with a thin cloth, is also an efficient method. About twenty-five tractions to the minute is the usual rate. The motions at the base of the tongue result in reflex irritation of the respiratory center, the responding nerves being the superior laryngeal, glossopharyngeal, the lingual, and the phrenic. Laborde's method can be utilized while the infant is immersed in a warm bath.

In the severe form of asphyxia and in prematurely born children most remarkable results are sometimes obtained by keeping these children in some kind of a warming apparatus or incubator (see Figs. 162, 163, p. 389).

Caput Succedaneum.—In quite a number of cases there are seen immediately or very soon after birth enlargements, contusions, or ecchymoses on the head or the presenting part of the child.

One of the most frequent enlargements noticed is named *caput succedaneum.*

This phenomenon, which is rather constant, consists of a swelling, of varying shape and size, noticed upon the presenting part, especially the head. The swelling is produced usually by pressure of the dilating os uteri, but the same kind of a swelling has been noticed upon the breech or the shoulder. The phenomena produced vary somewhat with the differences of position and extent and severity of the pressure.

Etiology.—The cause, as remarked above, has always been ascribed to pressure upon the unyielding os uteri, causing an infiltration of bloody serum in the tissues of the scalp below the constricting ring of the cervix; but inasmuch as this enlargement and the blood-tumor which will presently be described have been found on other than the presenting part, we must at this time confess that the cause is not always clear. It is possible that difficult labors with prolonged pressure by different parts of the uterus may be an etiological factor.

The pathology consists of a localized edematous condition of the soft parts of the scalp and the connective tissue with some extravasations of blood.

Diagnosis.—The diagnosis is not always easy, for there are found upon the head of a child several other enlargements from which the swelling must be differentiated. Chief among these enlargements are cephalhematoma, herniæ cerebri, vascular tumors, meningocele, encephalocele, and hydrencephalocele. A full description of cephalhematoma is given below, and herniæ of the brain and vascular tumors are treated on page 356, Vol. I. A brief description of the remaining three is as follows: *Meningocele* is a tumor of the scalp into which the meninges protrude; an *encephalocele* contains in addition to the meninges a small amount of brain-substance; and a *hydrencephalocele* contains a small amount of liquid in addition to brain-substance and the membrane.

Prognosis.—In caput succedaneum the prognosis is always good. If left alone, it almost entirely disappears within a short time.

Treatment.—Caput succedaneum will in every instance disappear without interference. In a case, however, where there is very extensive ecchymosis, which makes this the vulnerable point of the baby's body, care should be taken against infection. In this case an antiseptic dressing should be used as a protection.

Cephalhematoma.—Cephalhematoma is a soft, elastic, fluctuating tumor, generally painless and situated upon one of the cranial bones (Fig. 160). It is stated by some writers that the tumor occurs more frequently upon the right parietal bone. The tumors are usually single, although they may be double, one upon each side of the head. Hofmohl observed 26 bilateral cases, each with fontanelle between as a deep depression.

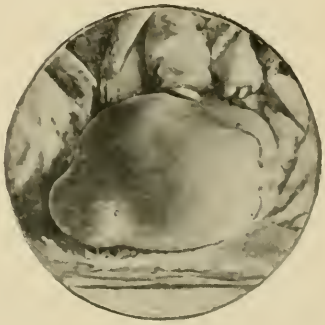


FIG. 160.—Cephalhematoma.

Frequency.—Cephalhematoma occurs with greater frequency than writers

would lead us to suppose. Henning had 230 out of 53,506 cases, or 0.43 per cent., and Hofmohl 371 in 59,885 cases, or 0.6 per cent. The disease is said to be more frequent in males.

Etiology.—This difficulty has in almost all instances been ascribed to pressure upon the cranial surface by the cervix uteri, producing a hemorrhage under the pericranium. Without doubt a great majority of cases are caused by this pressure, but from the fact that cephalhematomata have been observed in breech births, it must be admitted that in every case the rigidity of the os uteri does not produce the tumor. In addition to the pressure exerted either by an unyielding os or by forceps, there may exist, from undue thinness, a tendency on the part of the blood-vessels to rupture.

Symptoms.—This form of head tumor is not present usually at the birth of a child; indeed, from one to four days elapse before attention is called to this difficulty. When first noticed it is usually a soft, painless enlargement, situated upon a parietal bone, varying from the size of a hazelnut to that of an apple. It may so extend as to include the surface of the entire cranial bone, but it never crosses a suture or a fontanelle. There is no discoloration of the skin, and neither the pulse nor the circulation of the child is accelerated to an extent that would denote any disease or complication. The greatest size of the tumor is usually reached at the end of a week; it then remains stationary for a few days, and then begin the subsidence and diminution by which nature perfects a cure. In a large number of cases in from four to ten weeks there is nothing to indicate that there has been a tumor or a growth of any character.

Diagnosis.—The diagnosis is a very important question, and one not easily made out by many physicians. The principal affections with which a cephalhematoma may be confounded are caput succedaneum, hernia cerebri, erectile tumors or angiomata of the scalp, and the different forms of soft tumor that have been enumerated in the consideration of caput succedaneum, to which should be added the condition known as *craniotabes*. The means of differentiation may be briefly stated. Caput succedaneum is an edematous condition of the tissue of the scalp that is present at birth, and it disappears rapidly without any accompanying symptoms. It has a boggy feel, while in cephalhematoma there is always some fluid. The position, process of repair, and duration are also quite different. It should be remarked here that caput succedaneum may hide a cephalhematoma for three or four days. From hernia cerebri the differentiation should not be difficult. The hernia occurs along the line of a suture or in the vicinity of a fontanelle; there is no fluctuation, but usually there is a pulsation which is synchronous with the heart-beat. Cries and agitation of the child cause a hernia cerebri to enlarge; not so with a cephalhematoma. A vascular tumor on the scalp has the same boggy feel noticed in caput succedaneum, but it never fluctuates, and usually there is a discoloration of the skin that is not present in a cephalhematoma.

By craniotabes is meant the soft places found upon the cranial bones in rickety children. A layer of bone in some rickety children can be so thin

that a softness and fluctuation can almost be made out, thus giving rise to the suspicion that a blood-tumor of the scalp existed at that point.

The enlargements on the scalp caused by protrusion of the meninges alone, or those containing fluid or brain-substance, will need no further consideration than that given on page 344 of this volume, and page 356 of Vol. I.

Complications.—In a very few cases suppuration has taken place, or there has been such tension with pain as to interfere with the nutrition of the child. Of course, if pus is formed, necrosis may take place or a meningitis might be effected. The danger is reduced almost to *nil* if maltreatment is not inaugurated by some surgical process. A cephalhematoma caused by forceps delivery may make a fracture obscure, and is a dangerous complication.

Process of Repair.—At the end of four or five days (it is stated by one author after a single day) where the swelling joins the cranial bone a very small, hard ridge will be felt. This ridge is the beginning of a hyperostosis, or a throwing out of bony material by which the bone and periosteum are

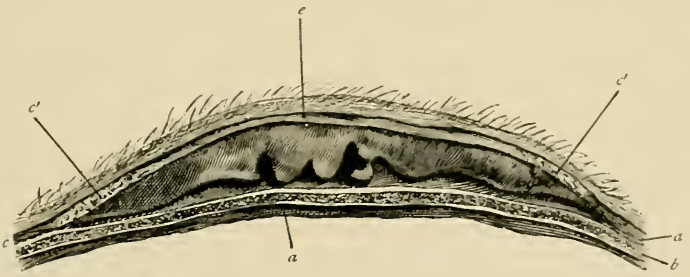


FIG. 161.—Longitudinal section through a cephalhematoma: *a*, dura mater; *b*, cranium; *c*, pericranium; *c'c'*, beginning hyperostosis; *c*, scalp (Davis).

repaired, a resorption of blood having now begun to take place. There is not only a ridge of bony material, but there are also forming forward, toward the central part of the tumor, little projections, so that after a time a thin crust or shell of bone is absolutely formed over the swelling. This crust will sometimes crackle like parchment. During this time the blood and serum are being resorbed, and while this course of repair is slow, in almost all cases a complete restoration has taken place without any induration or thickening. It has been stated that sometimes a hyperostosis remains at the seat of swelling.

Pathology.—A section through the blood-tumor (Fig. 161) reveals the fact that an extravasation of blood has taken place between the bone and the pericranium. The bone-surface is roughened, and the pericranium is attached only to the margin of the bone, where inflammatory irritation produces a perceptible thickening.

Prognosis.—If, as remarked above, a cephalhematoma is left alone, the prognosis, almost without exception, is excellent. If there is present a general systemic disease, the probability of resolution is not so good.

Treatment.—Interference, except in cases which will be mentioned, with the

pretence that something is necessary deserves censure. Any deviation from this course is always fraught with danger. In regard to the advisability of surgical interference, Winckel and Olshausen advise opening the tumor at about the sixth or eighth day, yet a case was lost by one of these gentlemen following this procedure. Among those who advise against operation are Henoch, Baginsky, Zweifel, Biedert, and especially the surgeon F. Koenig. The weight of authority is certainly against operative measures so long as there are no signs of inflammatory reaction or of suppuration.

Apoplexy of the New-born.—The *etiology* of cerebral hemorrhage of early life differs from that in the adult. While in the latter it usually results from a diseased condition of the arteries, rendering them liable to rupture, or from hypertrophy of the heart, in the infant it is often due to venous congestion, the hemorrhage occurring in the capillary vessels of the pia mater or in the choroid plexus. The pia mater in early infancy is very delicate. Apoplexy may also occur as a complication of cephalhematoma; it may be due to compression of the umbilical cord, producing asphyxia; it may be associated with atelectasis. There is usually a history of difficult labor, impaired circulation, perhaps convulsions, but it also occurs without the existence of other injuries where labor has been of long duration. C. Runge has found collections of blood the size of a pigeon's egg in the dura mater. These collections have been observed after normal labors.

Laceration of the sinuses may produce very extensive hemorrhage which will prove fatal. Interference with the circulation during labor, or pressure produced by the cord about the neck of the fetus, or the presence of struma, is sometimes followed by cerebral hemorrhage. These cases are usually asphyxiated. If respiration can be established, paralysis is likely to follow. Paralysis is not always marked at first, but may be noticed in the course of months; it may be followed by contractures.

Congenital Atelectasis.—By atelectasis is meant a condition in which the lung-tissue remains unexpanded, or, having been filled with air, collapses and returns to its condition before birth. Thus atelectasis may be either congenital or acquired. In the congenital variety the child evinces some difficulty in breathing at birth. Sometimes it is asphyxiated, and at other times the trouble is made manifest by rapid breathing and the want of expansion of one or both sides of the chest.

Etiology.—Atelectasis does not seem to be due to congenital difficulties with the respiratory apparatus, for in many cases the lungs can be expanded post-mortem without difficulty, nor is it due to an enlarged thymus gland. The majority of those who have investigated the cause of this difficulty believe that it is due to natural weakness of the infant or to some debilitated condition of the mother, premature birth, etc., rendering the respiratory muscles too feeble to elevate the thorax during respiration. Asphyxia and pressure on the brain from any cause, producing paralysis of the respiratory centre, is also considered a cause.

Frequency.—Congenital atelectasis is not frequent. The writer has seen

but three or four cases of this condition—that is to say, where the condition lasted long enough to become very apparent.

Symptoms.—There is usually a cyanotic condition of the body of the child in congenital atelectasis; very soon the infant commences to cry, but respiration is exceedingly rapid and short. If a small portion of the lung is affected, the difficulty will be so temporary as hardly to be noticeable. If a considerable portion of the lung is congenitally collapsed, the difficulty in breathing will be more marked. Occasionally convulsions precede death.

Diagnosis.—The diagnosis, which is usually difficult, often not made during life, must be founded upon the rapid and irregular breathing, upon the cyanosis, and upon physical examination. The walls of the chest upon the affected side do not expand, and there is dulness on percussion.

Prognosis.—The prognosis depends on the extent and cause of the difficulty. If a large area is involved and the condition is accompanied by cerebral lesions, the prognosis will be unfavorable; if the area involved is small and unattended by cerebral lesions, the prognosis will be good.

Treatment.—The first object in treating congenital atelectasis must be to induce a deep inspiration. For this purpose an effort may be made to stimulate the respiratory muscles. Usually the only effective treatment is very gentle inflation of the lung through a soft catheter introduced into the larynx. Diffusible stimulants should be administered, the child must be surrounded by artificial heat, and everything must be done to support nutrition.

2. Traumatic Injuries of the New-born.

The principal factors in the production of injuries of the new-born are anomalies of the pelvis, deviations from the normal mechanism of labor, and the necessity for instrumental delivery; in addition, wounds of the presenting part are sometimes produced by the attendants either through ignorance or by rough handling.

A. Injuries to the Scalp, Face, Neck, Limbs, Trunk, and Bowels.—Wounds of the *scalp and face* are frequently produced when artificial delivery is found necessary. Pressure by the blades of the forceps may produce lacerations of the scalp and forehead, contusions of the face, and injury to the facial plexus of nerves. These wounds are frequently bilateral, corresponding with the points where the forceps was applied, and where there is unusual resistance either from the parturient canal of the mother or from the bones of the skull of the child. Injuries to the presenting part are sometimes also produced even in normal labor. Thus the scalp has been injured in the attempt to rupture what was supposed to be the bag of waters. Caput succedaneum has likewise been thus mistaken and punctured, and even eyes and eyelids have thus been injured.

Injuries to the *head* are frequently indicative of pelvic deformities in the mother; especially is this true of the contracted pelvis. If the conjugate diameter is diminished, the promontory of the sacrum usually produces pressure on a limited spot or on two or three spots near each other. A spoon-

shaped depression of the parietal bone may thus be produced. The neck of the fetus sometimes shows the effects of traction produced by long-continued extension. These effects are usually manifested by transverse striæ at the point where the strain of the integument was the greatest (Müller.) Sometimes subcutaneous lacerations occur, giving rise to more or less extensive extravasations of blood.

In the attempt to assist the after-coming head, especially if this is done by unskilful hands, a blood-tumor may form from a hemorrhage into the sheath of one of the sterno-cleido-mastoid muscles. This condition is known as *hematoma of the sterno-mastoid.* There is usually some laceration of the fibres of the muscles as well as injury to the vessels. This accident is more common in breech presentations, but it also occurs in head presentations, and has been observed after spontaneous delivery; in the latter case, however, the tumor is very small. The swelling is not always observed immediately after birth; it is generally irregular, somewhat elongated, situated usually in the upper part of the right sterno-cleido-mastoid, becoming harder, and disappearing in the course of from four to eight weeks. The *prognosis* is favorable as to the life of the child. Paralysis of the arm corresponding with the side on which the injury existed sometimes occurs, but this usually disappears with the tumor. This injury sometimes causes torticollis.

Fracture of the *clavicle,* in extracting the after-coming head, may result in puncture of the lung by the broken end of the bone.

In transverse presentations the upper extremities of the child are sometimes injured, the presenting arm being covered with excoriations, or the member may be considerably swollen. The large bowel may rupture from pre-existing ulceration, which is usually at the sigmoid flexure. Effusions of blood in the pleural and peritoneal cavities have been observed after difficult labor, and extraction of the feet or the breech is sometimes followed by injuries and lacerations of the abdominal viscera of the fetus.

B. Injuries to the Skull and Other Bones.—The head of the new-born infant is commonly distorted by the pressure of the pelvic walls in normal labors, each presentation and position causing its characteristic change in the shape of the infant's head, the distortion disappearing a few hours after delivery. Injuries of the fetus affecting the bones of the head and extremities may occur from the pressure of instruments, from the hand of the obstetrician, and also spontaneously as a result of very rapid labor, especially if birth takes place while the mother is standing. Fractures and lacerations of the sutures are likely to result from a contracted pelvis.

Injuries to the cranial bones may be complete or incomplete fractures or simply depressions; any of them are frequently associated with cephalhematoma and intracranial hemorrhage. Cranial fractures when at all marked are usually accompanied by an extracranial or intracranial hematoma. Peripheral fractures may sometimes be extensive, and yet not be followed by serious consequences. Injuries of the occipital bone sometimes prove very

serious, on account of compression of the occipital foramen. Occasionally injury to the medulla results.

Injuries to the spinal column sometimes result from traction on the child's feet or the breech in difficult labors. The injury consists usually in the separation of one or more of the epiphyses; the ligaments are usually unimpaired. Hemorrhages into the membranes may occur. Fractures of the clavicle and the humerus are likely to occur in breech presentations during the delivery of an arm. Separation of the epiphyses of the humerus may also occur, and it is liable to be mistaken for fracture of the neck of the scapula or for luxation of the humerus. This injury is always accompanied by an inward rotation of the humerus.

The treatment of these traumatic injuries, both of the soft parts and of the bones, will consist in observing the same rules as for corresponding injuries in older patients.

C. Injuries to the Brain and the Peripheral Nerves: Obstetrical Paralysis.—In some labors which have been terminated by the use of forceps, as well as some where manual interference is necessary, either from pressure by the forceps or by twisting or stretching or direct pressure of the hand, there is sometimes noticed slight paralysis either upon one side of the face or in one of the extremities. These lesions may be of peripheral or of central origin, the latter being usually the result of cerebral or of spinal hemorrhage. These hemorrhages have already been described (p. 348). Injuries to the nerves are usually an accompaniment of severe injuries of the bones, the fractured ends pressing upon the peripheral nerves or on some plexus. One form of paralysis is frequently produced in the attempt at delivering the arm: this form is known as Duchenne's obstetrical paralysis.

Sometimes there will be slight bruises or ecchymoses of the face, and, where manual interference has taken place, of the arms and legs. The first symptom noticed is generally the want of proper action of the muscles of the face. In some cases there will be retraction of the eyeball and contraction of the pupil, a slight drooping of the eyelid, usually some irregularity of the mouth, and want of expression of the side of the face involved. Where the paralysis involves an arm or a limb (Duchenne's paralysis) the muscles will appear soft and flabby and the usual motions will be absent.

The diagnosis of obstetrical paralysis can be made without difficulty, as it is hardly possible that anything else could produce the symptoms in a newborn infant.

Prognosis.—Paralysis of the face, the result of injury, usually disappears in the course of a few weeks. Paralysis involving larger trunks of nerves, and in cases where the injury has been considerable, will be longer in disappearing, and in quite a percentage of these cases some permanent deformity will remain.

Treatment.—In paralysis of the face little more is necessary than to protect the parts which are bruised and ecchymosed by an antiseptic dressing, and after a time to use massage and electricity. Where the injury is to one of the

extremities, the limb should be very carefully protected by wool or cotton, proper support being made so that no dragging shall take place, and at the end of two or three weeks the use of electricity and massage, with the administration of such internal remedies as are usually employed in such injuries, such as small doses of nux vomica with general tonics to improve nutrition. When all acute symptoms disappear and contractions begin to be noticed, special attention should be given to the prevention of deformities.

3. Deviations from Some of the Physiological Processes which Characterize the Early Life of the Infant.

There are a number of conditions and processes peculiar to the early life of the infant that are especially liable to produce pathological conditions.

Exfoliation of the Epidermis.—It is a fact that nearly all the organs and mucous membranes of the new-born are predisposed to congestion and to a catarrhal condition which is accompanied by exfoliation of the superficial layer of cells. The great delicacy of the skin and mucous membranes at this period is a decided predisposing cause to hemorrhage, and the great tendency to exfoliation readily affords entrance to the various forms of micro-organisms which produce disease. Epstein pointed out that during the first days of life, as a rule, considerable exfoliation of epithelium takes place in the mucous membrane of the oral cavity. In this cavity there are two points on either side of the posterior angle of the hard palate that in a great number of children present epithelial defects during the first days of life. Here the mucous membrane is very thin and anemic from the stretching of the pterygoid ligament in sucking and in opening the mouth. In these parts the superficial and deeper loss of epithelium occurs, especially if on attempting to wash the mouth of the new-born it is roughly handled. This shedding of epithelium is also particularly marked in the epithelium of the genital tract of female children.

Icterus Neonatorum.—Icterus of the new-born can hardly be spoken of as a disease, but rather as a phenomenon depending in many cases on natural processes of the first days of life. It occurs in from 79 to 84 per cent. of all infants (Porak, Cruse), and is most likely to occur in children prematurely born or when ligation of the cord has been delayed. The yellow skin-discoloration occurs usually several days after birth, but occasionally it exists in the pre-natal state. The discoloration of the skin is usually not accompanied by any symptoms of disease, and is not very marked, appearing first on the face, later on the trunk. In mild cases the sclerotics remain unaffected. This usual form of icterus neonatorum is physiological and is without serious symptoms; it usually disappears spontaneously within a week. If the bowels are sluggish, small doses of rhubarb or hydrargyrum cum creta may be given. The "symptomatic" form is more serious, on account of the pathological conditions with which it is associated, and from which it must be differentiated. It is considered on another page.

There have been many hypotheses as to the cause of the usual (the physiological) form of jaundice, but no explanation has been offered that is entirely

satisfactory. The two theories more generally considered are—first, that of *hematogenic* origin (Virchow's and others)—that is, the bile-pigment is supposed to originate in a rapid destruction of blood-corpuscles—and, second, the *hepatogenic* origin, in which the small common biliary duct fails to carry off excess of bile: these theories are fully described in the recent text-books on diseases of children.

Mastitis.—The mammary glands of infants, both male and female, often assume during the first two weeks a function similar to lactation in the adult woman. The milky fluid secreted closely resembles colostrum. This functional activity, being accompanied by congestion, is very likely to assume the form of inflammation, producing swelling, redness, and pain.

External irritation, such as pressure, attempts on the part of the attending midwife or nurse to squeeze out the milk, etc., increase the tendency toward inflammation. If properly cared for, this physiological swelling will soon subside; if irritated and perhaps subjected to much handling, producing abrasions of the epithelial covering, suppuration may occur. Infection of this gland is described on another page.

Prognosis and Treatment.—The prognosis is generally good. Prophylaxis occupies the first place in treatment. In cases accompanied by much swelling of the gland the latter may be dressed with vaselin and borated cotton. If swelling and redness of the skin occur, then the gland should be covered with an antiseptic wet dressing.

Diseases of the Navel.—Under this head we may consider—(1) Anatomical and physiological considerations, and dressing of the navel; (2) umbilical hemorrhage; (3) slight disturbances of healing of navel wounds; ulcerations and umbilical fungus; (4) umbilical hernia; umbilical fecal fistula; (5) diseases of the umbilical vessels; (6) omphalitis; (7) gangrene of the navel.

1. Anatomical and Physiological Considerations, and Dressing of the Navel.—Under normal conditions the umbilical cord desiccates and drops off from about the fourth to the sixth day after the birth of the child. The cicatrix should then look clean, but it will remain moist and rather soft until the tenth or the twelfth day. The dressing of the cord should be such as to assist this normal process and to prevent the formation of moist putrefaction.

As will appear in this discussion, the umbilical wound is the commonest atrium for infection which befalls the new-born, often with most disastrous results. To prevent this accident the most explicit directions in regard to the antiseptic treatment of the umbilicus should be given to the attendants. It is not sufficient to give the nurse verbal instructions simply to dress the cord as she thinks best, but it is the duty of the obstetrician to see not only that the cord is dressed in an antiseptic manner, but that it is also kept perfectly clean until the atrium for infection at this place is closed.

Some such method as the following for treating the stump should be adopted: After cleansing the child, the abdomen and the cord should be

washed with an antiseptic fluid—bichlorid solution (1 : 1000)—and the cord should be tied with a ligature that has previously been sterilized. The cord is now thoroughly washed with the same antiseptic liquid, and turned up a little to the left upon a piece of sterilized gauze. Both the gauze and the cord should be dusted over with boric acid, and then be covered by a compress of borated cotton. The cord should be thoroughly washed each day with sterilized water, and be dressed in the same manner each time. Particular attention should be paid to the stump after the cord has fallen off; it should be dressed with some antiseptic lotion, and the room in which the child is placed should carefully be guarded against all septic influences. Should decomposition of the cord take place previous to its separation, Eröss advises a dressing of bichlorid of mercury (1 : 1000).

2. Omphalorrhagia (Umbilical Hemorrhage).—Umbilical hemorrhage is no disease, but rather is a symptom of one of various pathological conditions. We distinguish two classes of omphalorrhagia: First, hemorrhage from the vessels of the umbilical cord; second, hemorrhage from the umbilical wound.

Hemorrhage from the Umbilical Vessels.—Of this class there are two varieties—one occurring before, and one after, the separation of the cord.

A. *Hemorrhage before the separation of the umbilical cord* may occur if the ligature is not properly tied. The ligature may be too loose, or it may have cut into the tissue of the cord, thus opening a blood-vessel, whereupon the hemorrhage takes place. But it does not follow that in every case of imperfect ligature of the cord a hemorrhage occurs. That this statement is true we know from numerous cases where, although no ligature had been used, no hemorrhage followed. At the birth of a living child, if it has cried lustily, a small amount of blood flows from the fetal end of the divided cord ten or fifteen minutes after the cord is cut through. This blood is never the bright red oxygenated blood. After a short time this slight hemorrhage stops.

The anatomical and pathological investigations made by B. F. Schultze will assist to understand fully the above facts, as well as others relating to diseases of the umbilical cord. With the first respiration of the new-born child the expansion of the lungs leads to distention of the blood-vessels of the thorax; thus the blood-pressure sinks in all the large vessels of the body. The greatest fall of the pressure occurs in the pulmonary artery, then in the aorta, then in the other large vessels, including the umbilical artery. Thus the pulse in the umbilical cord after a deep respiration is weakened and the arteries contain little blood. At the time the arterial pressure falls one observes in the umbilical vessels an exceedingly marked muscular contraction, and notices that the lumen of the vessels is rapidly reduced.

Strawinski, who studied the peculiar arrangement of the muscles of the umbilical arteries, found in them an internal longitudinal and an external circular layer of the vessels. He and Von Basch also demonstrated, by measurement made in the lower animals, the actual reduction in blood-pressure.

The umbilical cord no longer receives blood from the placenta; the blood it already held has been aspirated into the thorax, so that the vein becomes empty and its walls contracted, although less energetically than the walls of the artery. Expansion of the lungs and contraction of the muscular coat of the umbilical vessels are the two important factors which usually make severe hemorrhages from the umbilical cord of the new-born child impossible. It must be stated, also, that in many of the lower animals the tendency to hemorrhage is lessened by various conditions, such as traction of the cord and by its being bitten off. But even in the human offspring a great tendency to hemorrhage does not exist, even though the *ligature be not applied*. This fact has abundantly been corroborated by medico-legal experience, since in cases of illegitimate birth the cord is often cut by scissors and left untied, yet death by hemorrhage rarely occurs. If, however, in the new-born child the respiration is imperfect, causing only partial expansion of the lungs, then the umbilical vessels remain filled with blood and pulsate strongly.

If asphyxia of the first degree be the cause of imperfect respiration, the blood-pressure rises and the pulse becomes strong. In such a case, should the cord be severed and not ligated, profuse hemorrhage would usually follow. This fact explains most hemorrhages following imperfect ligation of the cord. When, however, such hemorrhages occur in mature and well-developed children, they must be due to insufficiency of the muscularis. Hoffman found that after birth the umbilical arteries do not contract evenly throughout their extra- and intra-abdominal extent, but that the contraction takes place in a centripetal direction. The pulsation is first weakened in the portion nearest the placenta, this weakening taking place progressively toward the umbilicus. For several minutes after the first respiration of the child there is still a full pulse-wave felt near the abdominal entrance, while the peripheral portion is bloodless and contracted.

It cannot yet be decided what causes the imperfect or only temporary contraction of the blood-vessels. It is possible that increase of arterial pressure—as, for instance, in asphyxia—diminishes the resistance of the muscularis; some authors believe that protracted warm baths may produce relaxation of the muscularis.

For the prevention of hemorrhage *a few days after birth* desiccation of the umbilical stump plays an important part. If the cord dries up normally, then the dry, hard portions effect a positive protection against the eventual occurrence of hemorrhage; if, however, the cord should become gangrenous, its vessels will become distended and may again become pervious. Some authors think that any obstruction to the return of venous blood to the heart may produce hemorrhage. Inasmuch as various conditions may arise that would prevent a physiologically bloodless condition of the umbilical cord and the obliteration of the umbilical vessels, it is to be urged in every case that the cord be carefully ligated.

Prophylaxis and Treatment: Ligation of the Cord.—The ligature should be placed about two or three fingers' width from the navel. Particular care

must be taken with asphyxiated or premature children that the ligature is firm and that it does not cut into the tissues; for this reason a moist tape increases the security. If the cord is very thick, a second ligature may be applied after the cord is somewhat collapsed. The tape should be from 1.5 to 2 centimeters ($\frac{3}{4}$ inch) wide; in case of hemorrhage a second ligature must be applied. If the umbilical end is too short or has been thrown off, a compression bandage must be applied or the individual vessels must be secured by encircling stitches. If the infant is anemic, stimulants must be administered and artificial heat must be applied to prevent collapse. For very gelatinous cords Budin advises the use of the elastic ligature: he found that in these cases a slight blood-pressure may suffice to produce hemorrhage, even though the cord be ligated with a linen tape. Rough handling of the stump during desiccation must of course be avoided.

B. *Hemorrhage from the Umbilical Wound.*—(Omphalorrhagia; also called "Idiopathic" or "Spontaneous Hemorrhage.")—The appearance of a few drops of blood on the dressing immediately after the separation of the cord, even though this occur for several days, is not uncommon, and generally is of no importance. The pathological condition to be here described is the one usually associated with grave constitutional disturbance, generally terminating in death. Fortunately, this form of hemorrhage is very rare; Winckel found one case in 5000 births, male children being attacked more frequently than females, and strong, healthy children more frequently than the feeble. It is of interest to note the great number of cases of umbilical hemorrhage that have been reported in America in contrast with those in Europe. The condition occurs in the negro and the mulatto as well as in the white race. Grandidier, to whom the writer is indebted for much information, collected a summary of 220 cases.

The etiology of umbilical hemorrhage is still imperfectly understood, but it is evident that hemophilia is not the only cause. In "bleeders" umbilical hemorrhage is very rare; among 185 families of bleeders, with 575 individuals who were bleeders, spontaneous umbilical hemorrhage occurred only in nine families in twelve individuals, and in the latter it is a question whether in all of them it occurred without the bleeding of large blood-vessels. Moreover, in the cases of spontaneous hemorrhage that have recovered it has not been observed that there was a tendency to bleeding in later life, while in hemophilia the disposition to hemorrhage usually remains through life.

Grandidier offers the explanation of "transitory hemorrhagic diathesis" which has developed on account of changes in the respiration of the newborn; but this is only a suggestion as to a cause. The question is of interest whether the health of the parents, especially the mother, bears any relation to the disease. In Grandidier's cases syphilitic disease was present six times in the mother and twice in the father. American physicians state that the excessive use of alkaline remedies during pregnancy is the cause of this difficulty. Others consider the depressing influences, severe vomiting, and excessive thirst during pregnancy as possible causes. If the results of

post-mortem examination are examined, it will be found that the idiopathic umbilical hemorrhage is usually associated with one of the following conditions: (1) congenital syphilis; (2) sepsis; (3) acute fatty degeneration; (4) hemophilia.

Syphilis is a cause of umbilical hemorrhage. Not alone Grandidier, but other authors have found syphilis of the parents present in many cases of umbilical hemorrhage in children. The description of the syphilitic changes which the child showed during life, and which were found post-mortem, is sufficient to establish syphilis as an etiological factor. This opinion is rendered still more certain by the general tendency to hemorrhage in congenital syphilis. In cases of marked hemorrhagic diathesis it may happen that the hemorrhage takes place from the umbilical wound as well as from other organs.

Sepsis.—The observations of Weber, Ritter, and Epstein leave little doubt that sepsis of the new-born may give rise to idiopathic umbilical hemorrhage. It is known that capillary hemorrhages are of frequent occurrence in sepsis, but severe hemorrhages in various organs are also observed. Most of these cases were observed in orphan asylums. Epstein found among 51 children with this form of hemorrhage that 24 were suffering from acute septicemia. Extensive gangrene of various parts of the surface of the body is frequently associated with this form of hemorrhage.

Klebs and his follower, Eppinger, attribute the hemorrhages to the invasion of a micrococcus, the *monas hæmorrhagicum*. Often the blood-vessels in the neighborhood of the hemorrhage were filled with these micrococci, which were also found constantly in the blood. According to Cohn and Weigert, many cases of hemorrhage have been observed in which bacterial thrombus and embolism are the cause of the extravasations.

The occurrence of umbilical hemorrhage in *acute fatty degeneration* will be found fully considered on another page.

Symptoms and Physical Signs of all these Forms of Hemorrhage.—The hemorrhage generally manifests itself about the fifth day, usually just after, occasionally before, the separation of the cord. According to Minot, it may occur as late as the second or the third week; the subject may be well developed and apparently healthy. The hemorrhage does not arise from one or two distinct vessels, but oozes freely, like a fluid from a sponge. The bleeding may at first be so slight as to be mistaken for the physiological process above referred to, but its real significance will be manifested by the persistent oozing or in a hemorrhage so severe at first as rapidly to exhaust the strength of the little patient. There is often slight icterus, sometimes vomiting and colic, clay-colored stools, sometimes bloody discharge from the stomach and bowels; in severe cases cyanosis and somnolence are present, showing that there is a marked and grave constitutional disturbance. In the neighborhood of the umbilicus occur spots of ecchymosis, that also appear in other parts of the body, so that the whole child appears mottled with bluish-red spots. Edema of the ankles and the hands frequently occurs, and it may

extend to other parts of the subcutaneous connective tissue. Death may follow in several hours, but the patient may live for two or three weeks. Grandidier's statistics show a mortality of 83 per cent. Death is preceded by symptoms of collapse, coma, and occasionally convulsions.

Differential Diagnosis.—The diagnosis of this form of umbilical hemorrhage from the more common form first described is based on the grave constitutional disturbance which soon follows, and on the great difficulty, usually the impossibility, of checking the hemorrhage.

Therapeutics.—Since omphalorrhagia is a symptom of a number of constitutional diseases marked by a tendency to hemorrhage, the treatment directed solely toward the arrest of hemorrhage will scarcely suffice. Usually all attempts at arresting the hemorrhage are futile. The employment of a styptic is only a temporary measure; it may be combined with firm pressure upon the wound. The most successful treatment consists in ligature of the navel according to Dubois' method. A hare-lip pin is passed along the edge of the umbilical wound from left to right in such a way that the skin, but not the whole thickness of the abdominal wall, is included. By means of a thread passed beneath the pin the navel is now raised, and a second pin is passed under the first pin, and at right angles to it, through the abdominal wall. A figure-of-8 ligature is passed around the second pin, and, finally, circularly around the base of the navel. This method is said to have arrested the hemorrhage in a few cases. A plaster-of-Paris bandage has been advised. The attempt to search for the vessels with a view to ligating them is almost never successful. Hemorrhages occurring in other parts of the body are to be treated in a similar manner. The internal treatment should be directed to the cause, but thus far promises very little.

3. Slight Disturbance in Healing of Navel Wounds.—Occasionally when the process of desiccation of the cord has been incomplete, or when there has been some irritation of the navel by friction, especially when not kept perfectly clean, excoriation and even ulceration may occur. In this event the treatment consists in cleansing the wound with an antiseptic solution (3 per cent. boric acid) and in applying a mild astringent. Runge advises salicylic acid and starch (1 : 5 to 1 : 3). The stump in these cases should be dressed twice a day.

Umbilical Fungus.—If the wound heals slowly and secretes for a long time sero-purulent fluid, there sometimes then develops a red granular growth which bleeds readily, and from which there is more or less oozing of serous or sero-purulent fluid. This growth in some cases has a broad base; in other cases one or more of the growths are pedunculated, soft, and not sensitive. In the early weeks these growths may be visible only on retracting the surrounding integument, but later, if not arrested, they may form an elevation of considerable extent surrounded by excoriations. Usually the health of the child does not suffer. The fungus itself is not sensitive, but the surrounding excoriation may become painful. Histologically, this fungus is a granulation tumor. The wound in the navel, as a rule, cannot heal while the fungus

exists, although in very exceptional cases the growth may become covered with epidermis. This disease must be differentiated from the adenoma described by Küstner.

The treatment consists in cauterizing the growth with nitrate of silver and applying a salicylic-acid bandage. Removal by scissors is likely to produce considerable hemorrhage.

Diseases of the umbilical vessels, omphalitis, and gangrene of the cord are considered on other pages of this work.

4. Umbilical-cord Hernle (Herniæ Funiculi Umbilicalis).—Umbilical-cord hernia depends upon the arrest of development of the abdominal wall in the first stages of fetal life. Frequently other malformations are present, such as hare-lip, club-foot, hydrocephalus, and spina bifida. Lange found from a study of 21 cases collected in literature that in seventeen of them other malformations were also present. There will be considered in this discussion only such cases of umbilical-cord hernia as are not associated with other malformations which interfere with life.

Anatomy.—The umbilical-cord hernia is a round or an oval swelling in the umbilical region, varying in size from a nut to that of an orange; occasionally larger. The tumor may occupy the greater part of the abdominal wall. The hernial sac consists of peritoneum, covered by the amnion which originates from the umbilical cord and reaches the base of the swelling. The base of the swelling is continuous with defective integument. Sometimes a small part of the skin reaches a little over the tumor. Between the external covering and the peritoneum is a thin layer of Wharton's jelly. The amnion and peritoneum may be firmly united. The sac usually contains some intestine, at times also the liver, stomach, spleen, and other viscera, such as the kidneys and pancreas. Two or more of these viscera may be bound together by adhesions. The implantation of the umbilical cord is sometimes on the summit of the swelling, more often somewhat deeper. The umbilical vessels pass from the cord between the amnion and the peritoneum over the swelling to the abdominal defect, the veins passing to the liver and the arteries toward the bladder.

Clinical Appearance.—Immediately after birth the thin amniotic covering of the umbilical-cord hernia presents a grayish-white, translucent appearance; the presence of meconium in the intestines gives the swelling a dark green color. On palpation one may detect peristaltic motion of the intestine; the presence of a part or of the entire liver renders the contents of the tumor firmer. During the process of desiccation in the umbilical cord in the next few days the appearance of the hernia is much changed. The circular edge of skin at the base is reddened, and suppuration often takes place. After separation of the amnion active granulation may build up the edge of the ulcer. The wound-surface grows less, the edges contract, and finally the hernia may close by cicatricial contraction. Death often results. By rough handling the hernia may become gangrenous; in this case the gangrene is liable to extend into the contents of the sac, and the child dies of sepsis. In other cases suppuration

extends along the umbilical arteries or directly to the peritoneum, and death is due to arteritis umbilicalis or to peritonitis.

Diagnosis.—A case of large umbilical-cord hernia can scarcely be mistaken for anything else. Small herniæ of cylindrical form are more apt to lead to error in diagnosis. In all cases of marked swelling of the umbilical cord at its fetal insertion one should think of the possibility of hernia of the cord.

Prognosis.—Formerly the prognosis was considered always bad. In 1884, Lindfors taught that healing without operative measures might be procured by suitable retention. Previous to his time cases of healing by protection and compression had been reported. More recently the prognosis has become somewhat more favorable, but the mortality still remains high.

Treatment.—The treatment has already been indicated. It consists of two methods: first, favoring natural tendency to obliteration; and, second, the radical operation. The first method consists in favoring desiccation by applying careful antiseptic dressing of iodoform, aristol, zinc, or bismuth. The hernia should be protected by a cotton compress, and when the cord and amnion have dropped off granulation of the edges must be favored by the application of solutions of nitrate of silver. As soon as reduction seems possible it must very carefully be performed, and a compression pad be applied and held in place by adhesive straps.

Radical Operation.—If this method is chosen, the operation should be performed soon after birth. In this case all efforts at reposition are omitted. Twenty-four hours previous to the operation iodoform dressings are applied. The operation consists in making a circular incision into the skin at the base of the swelling, .2 to .5 centimeter ($\frac{1}{4}$ inch) outside of the sac, cutting down close to the peritoneum. After examination of the contents and separation of adhesions the abdominal wall is closed by interrupted sutures, taking care to bring the edges of the skin into perfect apposition.

In 1883 to 1889, Lindfors in his collection of 10 operative cases had seven recoveries. Since then he has added to the number. MacDonald in 1890 had 19 cases with seventeen recoveries. Since then other operators have met with happy results.

4. Infectious Diseases of the New-born.

It has long been observed that occasionally a child born in apparently perfect health, with good family history and with excellent hygienic surroundings, has developed during the first days of its life a disease characterized by high temperature, exhaustion, collapse, and death. Sometimes there has been found a local trouble which explained the cause of these phenomena, but frequently nothing could be noticed.

Frequency.—The occurrence of infection of the new-born is probably greater in private practice than is generally recognized. It is fair to suppose that in many infants attacked with fever and prostration, accompanied possibly with some jaundice and continued exhaustion, a fatal result takes place from septic infection. In hospitals a high percentage has always been acknowledged.

Miller found that 700 or 800 deaths occurred yearly from different forms of sepsis of the new-born.

Etiology.—In considering the etiology of sepsis of the new-born we cannot avoid some reference to the subject of sepsis *in utero*. After an extensive search through medical literature Von Holtz positively asserted that although septicemia *in utero* was rare, it undoubtedly occurred. For this early form of sepsis the two modes of genesis which have been assumed, and which have given rise to considerable debate and experimental research, are *placental infection* and *infection by aspiration of the amniotic fluid*. Although the placental transmission of septic micro-organisms from the mother to the fetus has not fully been demonstrated, either clinically or experimentally, this possibility can hardly be denied. Several cases accurately described by Weber, Buhl, and Orth leave little doubt as to this mode of infection. The theory of fetal sepsis produced by the aspiration of either putrid amniotic fluid or genital secretions seems probable from a case described by Küstner; experiments made by Hohenhausen and Geyl are cited in support of this theory, but the evidences are not conclusive.

Many other theories have been advanced on the means by which the organism of the new-born may be invaded by infectious matter. P. Müller made experiments to prove that disease-germs are transmitted from mother to child by means of the mother's milk. There has been demonstrated, on the one hand, the presence of staphylococci in the milk of septic puerperal women, but, on the other hand, since staphylococci have been found in the milk of healthy women, and since such milk has not been injurious to the children who were nourished by it, since also children nursing from women with septic diseases have remained healthy, the question of sepsis being transmitted through mother's milk must still be considered unsolved.

Air-infection is another theory, according to which the fetus that has aspirated amniotic fluid will contain a favorable culture-medium in its lungs for pathogenic germs that may exist in the sick-room.

Pathology.—Pathological conditions will differ according to the cause of the infection. In some cases the infection-atrium cannot be found: if it is the navel, diseases of blood-vessels will be found, with evidences of septic peritonitis and inflammation of other abdominal organs. If the infection has taken place through the mucous membranes, we find the pathological conditions present in the mouth, the larynx, and the upper air-passages, as well as in the intestinal mucous membrane. Evidences of septic pneumonia with bloody exudate into the pleura and pericardium have been found. Sometimes hemorrhages have taken place into the brain, the lungs, and the kidneys. This result is due partly to diseases of the liver and partly to inflammation of the veins of the umbilicus.

Symptoms.—The manifestations of infection of the new-born necessarily vary as different organs are involved or as the entire system is invaded. Many of these cases of infectious disease are characterized by a rapid loss of weight and by restlessness and insomnia. There is usually a rapid and shal-

low respiration, attended with vomiting and diarrhea. The temperature is frequently 105° F., but in some cases where the infection is profound collapse will early occur. Some of these attacks, with symptoms that are exceedingly severe for a short time, are aborted. In other cases nothing is observed until about the fifth or the seventh day, when usually there will be found in the region of the umbilicus some evidences of suppuration, or at least some redness, with possibly a bad odor. These symptoms are sometimes followed by diphtheritic exudates in different parts of the body. The child is fretful, its temperature rises to 102° F. or higher, very frequently the abdomen is hard and tender, and septic peritonitis and death follow.

Other symptoms, such as icterus and melena, may be associated with sepsis. They are not invariably present, and are sometimes described as special diseases. *Icterus*, in its general application, is considered on another page, but its special relation to sepsis will be considered under *Icterus Symptomaticus*, also under *Gastro-intestinal Hemorrhage*.

In other cases the symptoms are those which would come under one of the conditions presently to be described—infection of the umbilicus, erysipelas, mastitis.

Wound-infection.—The atrium for infection in the great majority of cases is doubtless through some wound, such as traumatic injuries due to delivery, or lesions of the mucous membranes due to physiological processes of desquamation, but, most frequently of all, through the umbilical wound. Prof. J. Lewis Smith makes the following classification: 1. Umbilical phlegmon, or local sepsis; 2. Sepsis following the introduction of poison through the umbilical vein; and 3. Sepsis received in other ways or through channels other than the umbilicus.

A. Infection through the Umbilicus.—This condition includes many of the abnormal conditions of the navel. The milder forms of infection interfering slightly with a normal healing process or producing ulceration are considered on page 358. The graver forms of infection of the umbilicus are diseases of the umbilical vessels, omphalitis, and gangrene.

Diseases of the Umbilical Vessels—Arteritis and Phlebitis.—According to Runge, arteritis and phlebitis of the umbilicus are of septic origin, the former occurring more frequently than the latter. The infection first attacks the perivascular connective tissue, extends to the adventitia, and produces dilatation and thrombosis, after which the disintegration of the thrombus may induce general sepsis, the infection being conveyed through the lymphatics. Occasionally localized disease of the vessels may produce death.

Symptoms.—There are no symptoms which would indicate with certainty the existence of arteritis or of phlebitis of the navel, but we can infer that these conditions exist where local ulcerative or suppurative processes are associated with much constitutional disturbance. The course of the diseases is often acute. A child who is apparently well may suddenly manifest restlessness, followed by collapse and death. At other times there are the usual symptoms of general sepsis.

Diagnosis, Prognosis, and Treatment.—The diagnosis usually cannot be

made definitely until after death. Cases of the milder form, occurring in children who are well developed, usually recover. For children prematurely born the prognosis is grave. The treatment consists in the use of antiseptic dressings, and in adopting all possible means to support the strength by nourishment and alcoholic stimulants.

Omphalitis.—This affection is an inflammation of the navel with phlegmon of the surrounding tissues. In the region of the navel there is a red swelling, at the apex of which the navel may be observed. Usually the healing of the wound is incomplete. The redness and inflammation extend in a circle around the stump, the skin is tense, without wrinkles, and glistening, and the abdominal wall is hard, infiltrated, and very sensitive. This infiltration may involve the greater part of the abdominal wall, and may even extend to the deeper tissues down to the peritoneum. The child is restless, has fever, pain upon every motion, even on respiration, and consequently assumes a fixed attitude; respiration becomes costal, the lower extremities are drawn up toward the abdomen and are held immovably in that position. On the surface of the abdomen dilated veins may be seen. The disease may last days or weeks. It usually begins in the second or the third week. The termination is favorable if the disease is not too extensive, but if inflammation involves the abdominal wall, peritonitis is likely to follow. If the navel vessels become diseased, gangrene may result.

Prognosis and Treatment.—The younger the child the more favorable is the prognosis. The treatment consists in the use of antiseptic dressings, of which salicylic acid and iodoform are the best. If suppuration takes place, the pus must be evacuated early. The constitutional treatment is the same as that for arteritis and phlebitis.

Gangrene of the Navel.—Gangrene arises from ulcers of the umbilicus, from general inflammation due to sepsis, and from cholera infantum. As a local infection of the navel it is not infrequent, especially when the patient is neglected.

Symptoms.—The margin of the wound of the navel becomes discolored and there is more or less oozing of a muddy fluid, or, in omphalitis, a vesicle may form containing turbid fluid. When this vesicle bursts it leaves a raw surface. The spreading of the moist gangrene may be rapid, may largely be on the surface of or deep in the navel; the latter condition is the most dangerous. There is always fetid odor. If the child is strong, then the process may become arrested and the defect may heal by granulation, but usually there is rapid loss of strength, terminating the second or the third day in death. Gangrene following cholera infantum usually terminates rapidly in general sepsis and death, but this fatal termination has occurred as late as the twenty-third day. Peritonitis sometimes occurs in which perforation of the intestines may take place, leaving a fecal fistula. Profuse hemorrhage is one of the probable complications.

Treatment.—A 3 per cent. solution of acetum aluminum, applied with a compress covered with rubber cloth, acts antiseptically and hastens the separa-

tion of the slough; after that the indications for treatment are to support the strength by nourishment and alcoholic stimulants.

B. Infection of Other Wounds.—Various injuries upon the body of the child may lead to wound-infection the same as occurs in the navel wound. In pre-antiseptic times frequently small, insignificant injuries of the skin of the child from pressure of the forceps were followed by phlegmonous inflammation about the injury, and sometimes by general sepsis. The infection in such cases was transmitted by unclean instruments or hands during labor or after the birth of the child. In a similar manner various infections may follow if operations are done upon the child and asepsis and antisepsis are not observed, as in opening a cephalhematoma, in operating for umbilical hernia or spina bifida, in opening a mammary abscess, etc. It may occur in the cutting of the band in a tongue-tied child or through the ritual of circumcision. The most frequent entrance of infection is through the defects in the epidermis and mucosa produced by the tendency to exfoliation referred to on page 352.

The infection may also take place about the buttocks if the bed or the clothing be impregnated with septic material. Infections about the mouth and the buttocks may lead to severe intestinal inflammation. Through the mucous membrane of the genital tract of the female child infection may also take place on account of the shedding of epithelium, and the infection may take on a diphtheritic nature and lead to gangrene of the external genital organs, terminating in the death of the child. Gonorrheal infection from the parturient canal of the mother is doubtless often transmitted to the genital tract of the female child, leading to obstinate leucorrheal discharges which occur in early life.

Erysipelas.—Upon taking up a work on *Diseases of Children,* written in 1800 by Michael Underwood, the writer found under the head of "Infantile Erysipelas" a description of unquestionably septic processes which to-day would be charged to bacterial infection. The writer is tempted to quote freely from this old work, both from the general interest in a voice from the past and from its particular aptness and historical value. The author says: "This disease does not appear to be distinctly noticed by any preceding writer. The French have, indeed, spoken lately of a somewhat similar affection, combined with other complaints infesting crowded hospitals, but the disease does not appear to have been anywhere noticed in its simple and genuine form. I think it may with propriety be termed the Infantile Erysipelas. It is a very dangerous species of that spurious inflammation, and it is not very often met with outside of lying-in hospitals. The ordinary time of its attacks is a few days after birth, but it is sometimes met with much later. It seizes upon the most robust as well as delicate children, and in an instantaneous manner; the progress is rapid; the skin turns of a purplish hue, and soon becomes exceedingly hard.

"The milder species of it appears often on the fingers and hands or the feet and ankles, and sometimes upon or near the joints, forming matter in a very

short time. The more violent kind is generally seated about the share-bone (or pelvis), and extends upward on the belly and down the thighs and legs, though sometimes it begins in the neck, and is equally fatal." (The author believed it more dangerous as it affects the central part of the body.) "In a few instances the disease has been attended by some varieties. Infants have not only come into the world with several hard and inflammatory patches and ichorous blisters about the belly and thighs, but with other spots already actually in a state of mortification."

Since the time of Underwood it has been noticed that epidemics of puerperal infection have been followed by deaths of a considerable number of children from erysipelas or local phlegmon or from diseases of the internal organs not so easily differentiated. It has remained, however, for the new pathology of the present generation to give a fair explanation of its etiology.

It has been found, on the one hand, that no micro-organisms are present in vessels of the stump of the navel cord which has been removed under the strictest antiseptic precautions; on the other hand, it has been demonstrated that germs of various diseases exist in the cord and blood-vessels of children who suffer from symptoms which have been named above.

The following is the history of a case of erysipelas vulvæ: C. B., age three months, twin, female. Four days after the boy twin was circumcised by a rabbi the baby girl was taken sick. The preputial wound of the boy healed nicely after having a slight purulent secretion for a few days. Diapers were used in common for both babies. The temperature of the female twin was soon 105° F., pulse 140, and there were swelling and redness of the labia, in a few hours extending to the thighs and lower part of the back. The redness was shiny, and clearly defined with slightly raised margin. On the second day the process had extended over the entire back. On the evening of the second day the temperature was 105° and the pulse 160, and the child was restless. There was typical Cheyne-Stokes respiration. During the next three days the process abated over the back, but extended downward, involving thighs, legs, and feet. At the end of twelve days the swelling and redness had all disappeared. As soon as the process began to lessen on the trunk and extend to the lower extremities the condition of the patient began to improve.

Peritonitis.—Acute peritonitis in the new-born is always septic, and it usually results from the absorption of septic material at the umbilical wound or from umbilical phlebitis or arteritis. It is almost unknown in private practice. Runge found only four cases of peritonitis among 55 post-mortems in infants dying of umbilical arteritis and of septicæmia the result of puerperal infection. In puerperal peritonitis death most commonly occurs within a week. Pleuro-pneumonia occasionally exists in these cases of septic infection.

Symptoms and Treatment.—The early *symptoms* are usually those of erysipelas around the base of the cord. There may be vomiting, diarrhœa, jaundice, distention of the abdomen, fever, and wasting. The *treatment* of both peritonitis and pleuro-pneumonia at this early period of life consists chiefly

of prophylactic measures. When the diseases have appeared, notwithstanding prophylaxis, the main reliance is free stimulation.

Phlegmasia.—This disease, which takes place in a considerable number of infants, is analogous to phlegmasia in adults, except in certain modifications with respect to the special anatomy of the first days after birth. It is undoubtedly a septic infection, usually associated with septic disease of the blood-vessels of the cord.

Parotitis.—A case of suppurative parotitis with a fatal result, and septic infection through the umbilicus, producing endocarditis, and resulting fatally at the eighth week, has been placed on record.

Mastitis.—The milder form of mastitis has been described on page 353. The mammary gland often gives entrance to infection, either by way of the milk-ducts or through slight injuries to the nipple, owing to improper manipulation or from pressure or bruising of the gland. If, in case of slight infection, the little gland is carefully guarded against new invasions, and is dressed with boric acid or with a solution of the bichlorid of mercury, the hardness and pain usually disappear, and the result will be all that one could desire. If, however, the breast is mechanically irritated, and thus made more vulnerable, and if attention to cleanliness be neglected, pus in all probability will form.

Symptoms.—The infection begins usually in the second week of life, with marked redness of the overlying skin and increased tenderness upon pressure. If at this point the disease is not averted, then there is an increase in the swelling, redness, and tenderness. The diseased gland becomes increased in size, usually in circumscribed portions. With the developing redness of the skin there are formed in the gland abscesses which finally rupture and discharge one or two teaspoonfuls of pus. During the abscess-formation the child is restless and its temperature high. After the discharge of the pus convalescence is usually uninterrupted and the cavity rapidly heals. Secondary abscesses are seldom formed; the disease usually involves but one of the glands. In other cases the disease does not remain limited to the gland, but extends to the surrounding tissue; it then becomes *perimastitis*. In this case the extension of the infiltration may be very great, reaching to the axillary space. Then the temperature rises very high and there is rapid loss of weight. As soon as the abscess is opened the symptoms abate. The contents of these abscesses may be very fetid and contain sloughs of tissue. In such cases death from sepsis has been recorded.

Dr. Bush narrates the following extremely interesting case of sepsis of the new-born: A healthy child, born at full term, weighing nine pounds. In seven days the cord fell off, leaving a granulating surface. On the fifth day of life the mammary glands were swollen and some fluid exuded. In two days there was greater swelling in the left, but not in the right, side. Five days later (twelfth day) the entire right side, half of the thorax from the middle of the sternum to the axillary line, were hot, swollen, hard, dusky-red in color, with fluctuation about the breast. Green stools and fever were present. Open-

ing of the abscess evacuated 30 cubic centimeters (1 ounce) of sero-sanguinolent fluid with some tissue. There was a constant discharge of bloody, foul-smelling matter, but for the time the child improved. Two days later there was a second opening, and ultimately large ulcers formed, which extended to the ribs, so that the pleura lay naked at the bottom of the wound, death taking place at the end of ten weeks.

The prognosis is generally good, but in the development of the glandular function at a later period of life atrophy of the diseased gland may follow. In female children this atrophy may interfere with the function of lactation later in life; it may also lead to retraction of the nipples.

Treatment.—The prophylactic treatment for mild forms of mastitis has been indicated on page 353. If swelling and redness of the skin occur, then the gland should be covered with a wet antiseptic dressing. If suppuration occurs, the abscess should be opened early. The incision is made in the direction radiating from the nipple; the after-treatment is according to general surgical principles. If the tissues outside the gland are involved, then early incision is indicated. Carbolic preparations in the treatment of these wounds should be avoided. The little patient's strength must be supported by appropriate food and stimulants.

Tetanus Neonatorum.—This disease consists of tonic spasms of the masseters, extending rapidly to the voluntary muscles. The disease usually begins at the time of the separation of the stump of the cord—that is, from the fifth to the ninth day after birth. It is now much less frequent than in former years. An examination of early literature on pediatrics shows that in olden times death from this disease very frequently occurred.

Etiology.—Formerly the cause of this disease was assigned to various conditions; dense population was thought to be a predisposing cause, locality another (Keating). It is particularly common in the tropics. In East India and in Africa the disease is particularly fatal; in Jamaica 25 per cent. of the negro children die each year. In New Orleans and in Baltimore the mortality from this source was formerly very great. Pressure upon the brain and neglect of ordinary care of the infant were also considered special causes; upon closer study, however, it seems that one cause, common to all, is filth.

According to the recent teachings of Pathology, tetanus is a wound-infection (Brieger) produced by the tetanus bacilli, inoculating, as a rule, the navel wound and there producing ptomaïns (described by Brieger), of which *tetanin* is the most characteristic. Any wound of the new-born may thus be inoculated. It has been proven that these bacilli occur upon the surface of the earth, particularly in the dust that accumulates upon the floors of houses. It is easily understood how in this way the bacilli may be introduced into a wound, especially under conditions unfavorable to asepsis. It is also apparent why in tropical regions, in crowded cities, and among the poor this disease has been of such frightful prevalence. Hartigan and Hirsch describe the disease

as occurring very frequently among the negroes, with whom it is a practice to apply to the navel the roots of certain plants.

Pathological Anatomy.—Autopsies have thus far shown nothing characteristic of the disease. There are usually exudates of bloody serum in the spinal meninges, and some extravasations of blood which may be the result of the violent spasms. Similar changes are found in strychnin tetanus. The other organs show nothing characteristic or constant. The navel wound may seem perfectly normal; occasionally there is suppuration of the wound and some disease of the vessels.

Symptoms.—The most marked symptoms are those pertaining to the muscular system. Premonitory symptoms are usually present for many hours, and sometimes days: restlessness, sudden cries during sleep, difficulty in nursing, rigidity of the muscles of mastication, these muscles being as hard as wood. The mouth cannot be opened, the lips are pressed together, sometimes protruding; the brow is corrugated; at times there is an extreme sensitiveness of the entire surface of the body. Later there is difficulty in swallowing, which frequently becomes impossible. Pulse and respiration are frequent, and there are sometimes diarrhea and urinary disturbances. When the muscles of mastication are involved, this condition is called "trismus;" when there is general rigidity of all the muscles, we speak of it as "tetanus." The opisthotonos by this time is particularly noticeable, and the abdomen is also hard; the arms and hands are flexed. As a general thing, however, the muscles of the body are less involved than those of mastication; the convulsions are at first clonic, becoming after awhile continuous. The respiratory muscles are only slightly affected. Spasms of the laryngeal muscles may cause sudden death. Laceration of muscles and fracture of bones have occurred as complications of the disease; paralysis of groups of muscles may remain.

Diagnosis and Prognosis.—The diagnosis is based on spasm of the masseter muscles, followed by opisthotonos and general hyperesthesia. Unless treatment is commenced early the outlook is unfavorable. The attacks become more frequent and more intense, the patient loses flesh, hyperesthesia of the skin accompanies rigidity of the muscular system, and finally death takes place.

The prophylactic treatment consists in observing absolute cleanliness on the part of the attendants. The antiseptic treatment of the umbilical wound must be insisted upon. Long before the nature of tetanus was understood cauterization of the umbilical wound was employed. When the disease is fully developed, its management consists in making the symptoms as light as possible and in supporting the strength of the child. The little patient should be isolated. The first indication is usually met by means of narcotics, among which chloral is useful: 1½ grains may be given by the mouth, and twice that amount by the rectum; 15 to 30 grains may be given per diem. Opium does not meet with much favor. Chloroform inhalations are also useful. The action of the narcotics is increased by the use of hot baths every one to three

hours. A great many other narcotics have been recommended, such as the bromids, extract of Calabar bean, atropin, etc.

Icterus Symptomaticus.—The icterus which is often associated with infectious disease is designated the "symptomatic form of icterus." It occurs in septicemia, in syphilis, in Winckel's disease, and in Buhl's disease. It is this association with grave constitutional disturbances that distinguishes it from the mild form described on page 352. In this grave form the discoloration is more marked, the sclerotic is usually deeply tinted, and there is rapid loss of body-weight. There is also marked increase of urea and uric acid in the urine.

The pathological conditions at this time of life that are most commonly met with in icterus are—obliteration of the hepatic duct, due either to congenital stricture or to syphilitic perihepatitis, septicemia, Buhl's disease, and Winckel's disease.

Treatment.—The treatment for icterus is indicated by the condition on which it depends.

Buhl's Disease (Acute Fatty Degeneration).—*Pathogenesis and Etiology.*—In 1860, Buhl described a disease whose anatomical characteristics were parenchymatous inflammation and fatty degeneration and hemorrhages in the heart, the liver, and the kidneys. The cause of this disease is not yet known. Some authors deny, while others accept, a septic infection (Müller). Bigelow found micro-organisms in the organs in cases of acute fatty degeneration.

Pathological Anatomy.—The body is cyanotic, and it usually shows icterus and edema; not seldom ecchymosis is found in the skin. The umbilical wound and vessels are normal. In almost all the internal organs hemorrhages the size of a pin-head or larger are found; they are also found in the meninges, the pleura, pericardium, peritoneum, thymus gland, and muscles. In the lungs hemorrhagic infarcts occur, and bloody mucus or clear blood is found in the bronchi. In the heart-muscle, the liver, and the kidneys fatty degeneration is present. In the stomach and intestines much blood is found; the kidney parenchyma presents many hemorrhagic foci; the spleen-pulp is very soft.

Symptoms.—Most of the children with Buhl's disease are born asphyxiated, although the labor is easy and rapid. The asphyxia is but partially, or not at all, overcome. Deep inspiration and lusty crying do not occur, and soon severe cyanosis supervenes, at which time many of these children die. If death does not occur, there follows upon the evacuation of the meconium a diarrhea, with some blood, and later entirely bloody stools and the vomiting of blood. With the separation of the cord there frequently ensues parenchymatous hemorrhage from the umbilical wound. At the same time hemorrhage from the mucous membrane of the mouth, the nose, the conjunctivæ, and from the external ear and skin, takes place, whereupon icterus develops, which in long-continued cases becomes extreme. Later, edema of the skin occurs, and death from collapse follows, without any marked elevation of temperature, usually about the end of the second week. Death may be preceded by only one of

the above symptoms, such as cyanosis or hemorrhage. Buhl's disease is rare, and has only been seen in lying-in hospitals.

Diagnosis, Prognosis, and Treatment.—The *diagnosis* has rarely been made during life, and only positively post-mortem after microscopic examination of the fatty organs. The *prognosis* in this affection is always fatal. The asphyxia is treated on general principles, and every effort must be made to support the strength of the patient.

Winckel's Disease.—*Symptoms.*—In 1879, Winckel described a disease, observed in the Dresden lying-in hospital, that was characterized by cyanosis, icterus, hemoglobinuria, somnolence, and rapid collapse without fever. Twenty-four cases were observed, only one of which ended in recovery. The sickness began with restlessness and cyanotic discolorations, after which there occurred icterus, vomiting, and diarrhea, and later convulsions, collapse, and death. The urine was pale brown, owing to the presence of hemoglobin. The urine contained also renal epithelium, granular casts with blood-corpuscles, micrococci, detritus, and some albumin. The urine was of a syrupy consistence, dark brown, and could be expressed on the cut surface of the kidney only on firm pressure. The mothers of the sick children all remained well.

Pathological Anatomy.—The condition of the kidneys was characteristic. The cortex was of a brown color and was beset with hemorrhagic spots. The pyramids were dark red, with infarcts of hemogloblin in the apices. In the bladder there was dark urine. In almost all the organs and in the serous membranes punctiform hemorrhages were found. Moreover, there was, as a rule, swelling of Peyer's patches and of the mesenteric lymph-glands. In the blood the white corpuscles were increased and the red ones enlarged, and fine granular bodies in rapid motion were seen in the plasma. The liver, and at times the heart, showed fatty degenerations. The liver and the kidneys in some cases presented collections of bacteria. Cyanosis and jaundice of the external skin and internal organs were observed.

Two similar cases were previously observed by Parrot (1873); further, Bigelow saw ten epidemic cases, and several sporadic cases were noted by Epstein in the foundling hospital of Prague. Two such cases have been described by Herz. In all the cases hemoglobinuria was absent or not looked for.

Etiology.—The last-named two authors claim a septic origin of the disease. Winckel could not discover the exact cause of the disease. Poisoning by phosphorus, potassium chlorate, carbolic acid, and arsenic could surely be excluded.

Melena Neonatorum.—Melena means, literally, "black disease," on account of the black (bloody) masses which are vomited or passed in the stools. According to our present knowledge, it is difficult to classify this condition, inasmuch as it must be regarded as a symptom of one of several diseases. It occurs in general sepsis, in syphilis, and in Buhl's disease. Some authors speak of it in connection with hemophilia. The condition is fully described under *Gastro-intestinal Hemorrhage* (p. 379).

Pemphigus.—Pemphigus neonatorum, apart from syphilis, is rare in

infants. There are two varieties, the benign, which is not accompanied by marked constitutional disturbance, and the malignant, which is a grave infection and presents the symptoms of rapid heart action, high fever, and great exhaustion. The eruption is characterized by the appearance of numerous vesicles, which develop rapidly, then rupture, and soon dry up. There then remains a moist surface, which heals after a few days without the formation of a cicatrix. Each vesicle is placed upon a reddened base. The vesicles consist of a raised superficial portion of the epidermis with exudates beneath. The vesicles are round or oval, and vary in size from that of a pea to that of a pigeon's or a hen's egg, and have considerable resemblance to burn-blisters. Their number is variable; there may be a single vesicle or a great part of the body may be covered with them. The vesicles contain a yellowish serum, which may later become more turbid and of a purulent appearance. The vesicles appear by preference on the abdomen, around the navel, or on any part of the trunk, or the head, and less frequently on the extremities, rarely on the palms of the hands and soles of the feet, a fact of considerable value in differentiating syphilitic pemphigus. The eruption on the extremities is usually not marked. The vesicles generally develop suddenly, occasionally over night; previous to the eruption the child may, but ordinarily does not, manifest irritability and disturbance of health; the eruption is prone to occur in successive attacks. The disease begins from the fourth to the ninth day of life; after the fourteenth day up to the third week its course, as a rule, is ended. In very severe cases high temperature may occur, followed by exhaustion and death. As complications and sequelæ there may occur furunculosis and other ulcerative processes leaving scars. Umbilical suppuration and disease of the umbilical vessels are described as complications in fatal cases.

Etiology.—There seems to be no doubt that pemphigus of the new-born is an infectious disease. It occurs in well-described epidemics and endemics, partly in cities and partly in asylums, sometimes in the practice of a single midwife. Many epidemics have been observed since 1834 in maternities in cities and in the practice of midwives. The first cause of such epidemics still remains undecided. Often these epidemics may be traced to a single person. The disease has been transmitted from the nursing infant to the mother or the wet-nurse, manifesting itself on the mammary gland, but, as a rule, the infection of adults is rare. It is probably of bacteriological origin, but the specific germ has not been demonstrated. Bloch * reported 18 cases. In 8 cases the staphylococcus pyogenes was found in the heart-blood. This eruption must not be confounded with that of congenital syphilis, although there is some resemblance between them.

The treatment of pemphigus consists in protecting the blisters from injuries; in case of rupture of the vesicles starch or pulverized salicylic acid and starch should be applied. Where the eruption is excessive warm baths give much comfort. After the bath the patient is wrapped up in cotton. In case of ulceration this should be treated on general principles. The malignant cases

* *Arch. f. Kind.*, Bd. xxviii., H. 1, 2.

require stimulation with alcohol, digitalis, strychnin, enemata of salt solution, and regular feeding.

Syphilis.—Syphilis in early infancy naturally comes under two heads, the acquired and the hereditary form. The hereditary form is considered under *Diseases of the Fetus in Utero* (p. 347, Vol. I.).

Etiology.—According to Fournier, children acquire syphilis more often than is usually supposed. The causes for contagion after birth are usually the following:

1. Nursing, by which a syphilitic nurse infects the child, or in which the nurse, being herself uninfected, nurses at the same time a second child which is syphilitic. Infants not only contract syphilis from members of the family and the nurses, but, as Keating says, "syphilitic infants are sources of danger to non-syphilitic members of the family, and numerous cases are seen in which the baby has infected its grandparents, nurses, and other infants." In these cases the infection is transmitted by means of patches developed about or in the infant's mouth; sometimes papules are the medium of contagion.

2. Infection may take place through the mother subsequently infected or through attendants, especially by kissing.

3. The poison may be inoculated by the midwife's or the physician's instruments or by the hands.

The question whether syphilis is ever transmitted through the milk of the mother or that of the wet-nurse is important. We have no evidence to show that this is done. Discharges from primary sores are liable to inoculate; also discharges from various secondary lesions, whether these are acquired or are hereditary. Infants suffering from syphilitic coryza or specific ulceration may inoculate the breast of a wet-nurse, but probably never that of the mother. Vaccination has been the means of introducing syphilis. Vaccina syphilis manifests itself not earlier than a month or six weeks after vaccination; it does so by the formation of a chancre at the seat of the vaccination (Hutchinson).

The symptoms of syphilis in early infancy will be found on p. 348, Vol. I.

Treatment.—The treatment of infantile syphilis, like that of the adult, consists chiefly in the use of mercurials. Mucous patches may be dusted with calomel. For syphilitic coryza J. Lewis Smith advises Squibb's oleate of mercury, 2 per cent. For the general treatment the use of mercury by inunction has always given satisfactory results in the writer's experience. For inunction the oleate of mercury or the mercurial ointment should be used, the oleate in the strength of 2 per cent.; of the ointment, gr. v-x may be applied to a healthy part of the skin and be covered with a flannel binder. For internal medication calomel may be given in doses of gr. $\frac{1}{20}$–$\frac{1}{10}$ two or three times a day. When these mercurials produce diarrhea they may be combined with opium and aromatic powder or be omitted for a short period and again be resorted to. The child should, if possible, be nursed by its mother; if this cannot be carried out, it should be fed on artificial food. A wet-nurse should not be engaged.

Tuberculosis.—Acquired tuberculosis at the period of early infancy is very rare. Most authors, however, admit the possibility of transmission of the disease at this period of life. As producing causes are mentioned all those which lower vitality, especially syphilis and tuberculosis in the parent. Direct transmission from parent to child is possible, though perhaps not frequent. Roger and Garnier* found Koch's bacillus in the breast-milk of a woman dying seventeen days after childbirth, with miliary tuberculosis. There was no disease of the mammary glands. The woman's milk (4 c.c.) was injected into a rabbit, which died after thirty days with generalized tuberculosis. The infant died after six months with tubercles in the mesenteric glands, the liver, spleen, and kidneys. The intestine was thought to have been the point of entry of the tubercular infection. A tuberculous mother should not nurse her infant, kissing should be prohibited, and the child should sleep in a separate room (Jacobi). Experiments on the lower animals have demonstrated that tuberculosis may be transmitted by the ingestion of milk from tuberculous cows; this applies also to the use for the feeding of infants of milk thus affected that has not been boiled. Catarrhal conditions of the air-passages doubtless favor the invasion of the bacillus.

The diagnosis of tuberculosis in the very young cannot readily be made: if the disease is limited to the lungs, there is evidence of bronchial trouble. In these cases Epstein recommends passing a catheter into the larynx; this will produce a cough, during which sufficient mucus may adhere to the instrument for microscopical examination.

The treatment is chiefly prophylactic, as indicated above. When the disease is established in early infancy the same methods of treatment should be applied as those for older children.

Ophthalmia Neonatorum.—Ophthalmia of the new-born is a local affection contracted during birth. Before prophylactic measures were adopted this disease occurred in lying-in hospitals with alarming frequency. During 1868–69 in the lying-in hospital of the University of Berlin blennorrhea occurred in 5.6 per cent. of the births. In the Charité at Berlin from 12 to 14 per cent. were noted. Kilian gives the percentage at the maternity hospital of Berlin from 1826 to 1834 as being nearly 50 per cent. Since the introduction of Credé's prophylactic measures the percentage has been reduced almost to *nil.*

Etiology.—Some authorities assign different causes, such as irritating discharges of the parturient canal, whether specific or non-specific, exposure to bright light, cold, etc.—others (Unger, Bumm) pronounce all cases of ophthalmia neonatorum to be due to gonorrheal infection, the gonococcus of Neisser being alone the exciting cause. There is no doubt that the secretions of the parturient canal of the mother are usually the medium of conveying pyogenic germs. These secretions, coming in contact with the cornea of the infant, remain fixed for some time, giving rise to a purulent conjunctivitis which manifests itself on the third or the fifth day after birth. The eye may become

* *Progrès Médicale*, 1900.

infected previous to birth by the amniotic fluid, or later through the infectious material on the hands of attendants, etc. (Runge). Frequently the cornea becomes involved in this process, in which case extensive ulceration may occur resulting in loss of sight. Indirectly the disease may be transmitted from the eyes of one child thus affected to those of another; it may also be transmitted through unclean hands of attendants, unclean sponges, towels, and through water used for the bath.

Pathological Anatomy.—The changes produce excessive hyperemia and swelling of the palpebral mucosa, rendering it thick and uneven. Later there is proliferation of the epithelium, and beneath it is a diffuse infiltration of lymphoid cells. According to Bumm, the gonococci contained in the secretions invade the upper epithelial layer and find their way down to the papillary bodies, where this invasion excites marked hyperemia, producing later the profuse discharge. The cornea may remain clear, but it is liable to become invaded, showing points of ulceration; or a general infiltration may take place, resulting in an extensive destructive process.

Symptoms.—The first manifestations of this disease occur on the third or the fifth day after birth, and consist of redness and swelling of the palpebral and ocular conjunctiva. One or both eyes may be affected; sometimes the lids are glued together. The secretion is at first watery, containing flakes of fibrin; later it is purulent and very profuse. In the course of several days the secretion diminishes in quantity, and after six or eight weeks the disease assumes the form of chronic conjunctivitis.

The prognosis becomes unfavorable in cases in which the cornea is involved; 20 or 30 per cent. of the cases of blindness in children is due to corneal ulceration thus induced. Great care must be given to the cleansing of the vaginal canal in suspected cases of gonorrhea by the use of antiseptic douches previous to birth.

The treatment consists chiefly in prophylaxis. The duty of preventing the occurrence of this serious disease devolves upon every obstetrician. Immediately after birth, before the child has opened its eyes, all secretions upon and about the lids should carefully be washed away with sterilized water or with a 1 or 2 per cent. solution of boric acid.

In many hospitals Credé's method is that usually adopted—that is, after cleansing the eyes with water 1 drop of a 2 per cent. solution of nitrate of silver is dropped into each eye. Recently a 5 per cent. protargol solution has been substituted for the silver solution. At the first manifestation of the disease active measures should be adopted. Usually but one eye is affected; in that case the other eye should be protected by placing over it absorbent cotton, covering the cotton with a watch-crystal, and sealing this with collodion or with adhesive plaster; but the eye should be examined daily to be assured of its healthy state.

When the disease has been developed two forms are distinguished, the mild and the severe, each having two stages, the congestive and the purulent. In the mild form the treatment in the first stage consists of the application

of cold compresses. In the second stage the eye is cleansed every two hours with a saturated solution of boric acid, and a ½ per cent. solution of nitrate of silver is applied to the cul-de-sac.

In the severe form cold compresses are applied; the eye is cleansed by a solution of bichlorid of mercury (1 : 8000) and a saturated boric-acid solution used alternately every hour. As soon as suppuration is established the solution of nitrate of silver is applied to the cul-de-sac of the cornea. While making these applications to the upper everted lid the cornea must be protected by the lower lid, and *vice versâ* (Bettman). It is best to begin with a 2 per cent. solution, but should this fail to control the suppurative process a 4 per cent. solution may be employed, and should immediately be neutralized by a solution of salt. Should an ulcer of the cornea form, it is the practice of ophthalmologists to employ cautiously weak solutions of eserin (¼ to ½ grain to the ounce). When iritis or a central ulceration of the cornea is present atropin (gr. ij–iv to the ounce) is preferred. The first signs of poisoning by this drug should carefully be observed. When the swelling subsides and the discharge decreases, and especially when there is corneal haze, hot applications may be made. For the treatment of further complications the reader is referred to works on ophthalmology.

C. Infection of the Digestive and Respiratory Tracts.—**Septic Gastro-intestinal Catarrh.**—Infection through the mucous membrane of the mouth is characterized by a catarrhal state involving the intestinal tract. Epstein described the different degrees of invasion as septic catarrh, septic croup, and septic diphtheritis. Symptoms pointing to the gastro-intestinal canal, such as vomiting and diarrhea, with foul and acrid stools, are very common in those obscure infections of the new-born infant frequently observed in maternity hospitals. While the umbilicus is the most frequent point of infection, and despite the fact that the intestinal canal has a marvelous power to destroy micro-organisms and thus protect the infant, in some infants a lowered vitality, especially vulnerable mucous membranes, or an exceptionally virulent infection sometimes permits infection through the intestines which may be rapidly fatal. In addition to a vigorous supporting and stimulating treatment, these cases are sometimes apparently benefited by the administration of intestinal antiseptics and lavage of the large bowel with salt solution.

Thrush (*spore* or *soor*) is a local disease of the mucous membrane of the mouth due to the growth of a vegetable parasite, often designated *oïdium albicans*. Although the parasitic character of the disease has long been known, no definite botanical place has been assigned to the fungus. The presence of soor is very common among infants, and it occasionally occurs in the very young. It is of frequent occurrence in foundling homes. Artificial food and impaired nutrition favor its development. The disease manifests itself in the formation of white points resembling curdled milk; these patches coalesce and adhere to the mucosa, which becomes very tender. Nursing becomes difficult, and diarrhea often results from the disordered state of nutrition.

Diagnosis and Treatment.—The diagnosis is based on the occurrence of the

white patches above described. In doubtful cases a microscopical examination will reveal the nature of the disease. The *treatment* consists in removal of the patches, cleansing the mucosa, and supporting the strength of the patient. After each nursing the little patient's mouth should be washed carefully with a mild antiseptic fluid—boric acid, 5 per cent., or chlorate of potash, 2 per cent. The application should be made very gently to prevent unnecessary desquamation of the mucosa. If the child nurses from the breast, the nipples should be washed off carefully with a similar solution before and after nursing.

Gonorrheal infection will also produce an acute catarrhal inflammation of the mouth. The *treatment* is similar to that of thrush.

Stomatitis Aphthosa.—We are indebted to Bohn for giving this term a definite meaning, as there have been a number of varied pathological conditions of the mouth that were termed "aphthæ." Bohn limits the term to a pathological lesion of the mucous membrane of the mouth, which lesion is characterized by the formation of distinct discolored spots from which the epithelium denudes, leaving shallow ulcers. As to the anatomical nature of these spots, there is still considerable discussion, some holding that it is a true vesicular eruption, others that it is due to a solid exudation between the cutis and the epithelium.

The etiology is not settled. Although the disease is more likely to occur after the tenth month, it may occur in the young. Aphthæ are found in the mouths of many children in asylums, maternity hospitals, etc. Sometimes they seem to be conveyed from child to child by wet-nurses whom the children have in common, but the bacterial origin of the disease has not been demonstrated. This eruption frequently occurs in poorly-nourished children.

The treatment consists of antiseptic measures as regards nursing-bottles, care of the breast of the wet-nurses, etc. The child's mouth should be washed frequently with a solution of boric acid, 3 per cent.; the ulcerated portions may be touched with a solution of nitrate of silver.

Diphtheria.—Literature does not cite many cases of diphtheria in the new-born; characteristic cases, however, have been observed. J. Lewis Smith believes the new-born to be susceptible to this infection, and he reports several cases. In two of these cases umbilical phlegmon was also present. Lissner * reports a case in an infant aged nineteen days. There was membrane in the nares, bronchus, and tonsils. The obstruction prevented suckling; 800 antitoxin units were injected. The infant recovered in nine days. Diphtheria in the mother does not, as a rule, greatly endanger the child (Muller), although cases are on record in which the disease was transmitted directly from mother to child. The *treatment* is the same as that in older children.

Rhinitis.—The occurrence of persistent coryza in very young infants is frequently due to hereditary syphilis. This symptom usually does not manifest itself before the second month, but it may occur earlier. Non-syphilitic suppurative rhinitis may occur during the first few days of life, and may be due to infection from the discharges in the parturient canal.

* *Archiv f. Kinderh.*, Bd. xxxvi., H. 5 and 6.

The treatment of the simple catarrhal and suppurative rhinitis consists in cleansing the nasal passage with mild disinfecting solutions, as in older children; a small syringe or medicine-dropper may be used for this purpose.

5. General and Unclassified Diseases.

Sclerema neonatorum is a disease consisting of an induration of the skin and the subcutaneous cellular tissues, associated with rapid lowering of the body-temperature. The disease is hardly known outside of foundling homes and maternity hospitals.

Etiology.—The etiology is imperfectly understood. Baginsky suggests infectious agents. It has also been asserted that the disease is due to an excess in the tissues of the infant of palmytic acid, which solidifies at the low temperature accompanying the disease. There seems to be some relation between imperfect development of the fetal heart and sclerema (Demme). It occurs in cases of premature birth and in infants who are poorly nourished.

Symptoms.—The premonitory symptoms are slight: the skin is first red and then has a mottled appearance; these changes manifest themselves first upon the calves of the legs, on the dorsum of the feet, then upward, involving the thighs, the abdomen, the upper extremities, the face, and the head. The rectal temperature falls from the normal to 86° or even 83° F.; the pulse is weak, the excretions and secretions sluggish, and the edema which now forms renders the skin pale and hard; gradually the whole body becomes cold and rigid, and eventually sensibility is lost. Death occurs without convulsions. Occasionally the patient recovers; in these cases the infiltration subsides, the dorsum and soles of the feet being longest affected.

Pathological Anatomy.—The portions of the skin affected are either yellowish-white or present a mottled, bluish appearance. Incision through the infiltrated skin is followed by discharge of a yellowish or a reddish fluid from the cellular tissue. This fluid usually coagulates upon exposure to the air. The brain is edematous, rarely showing hemorrhagic spots. In the lungs there is usually atelectasis, occasionally evidence of lobar pneumonia. In some of the other organs there frequently are ecchymoses. This disease may be complicated by pneumonia, septic disease of the umbilicus, pemphigus, and syphilis.

Diagnosis and Prognosis.—The diagnosis is based chiefly on the infiltration of the skin and the falling of temperature. This edematous form of sclerema must be differentiated from the adipose form in older children; also from the usual forms of edema that are characterized by "pitting" on pressure. The prognosis is unfavorable.

Treatment.—The treatment consists chiefly in the application of artificial heat and massage and the administration of stimulants. Artificial heat is supplied both dry and by means of the bath. An incubator will be of service to maintain the temperature. Massage is given with the view to improving the circulation and favoring the absorption of the serum.

A. Money reports a case of sclerema neonatorum successfully treated by

friction over the indurated areas with sweet oil, together with daily inunction of blue ointment into the skin of the abdomen. This author excludes any evidence of syphilis in this case. Alfred Barrs also reports a case in which the induration entirely disappeared in two months on mercurial treatment. One-half grain of gray powder was administered night and morning. Stimulants must be administered frequently—whiskey, 3 to 5 drops every half hour. Aqua camphor and tincture of digitalis may be added with advantage. In all cases special care must be given to favor the nutrition of the child, for which purpose *gavage* will be of service.

Hemorrhagic Diathesis.—It will be noticed in a few cases that an infant exhibits within a short time after birth a tendency to bleed, at first perhaps from the umbilical region, then from mucous membranes of the different openings of the body, from the conjunctivæ, and finally from the integument. In other cases this tendency will be noticed upon a slight local injury which under ordinary circumstances would be insignificant.

Etiology.—Our knowledge in regard to the cause of the disease is rather indefinite, but in a majority of cases it may be traced to some constitutional or septic influence. The symptoms have already been stated above. Anemia naturally results.

Diagnosis.—If there is a family history of a tendency to hemorrhage, if the hemorrhage is persistent, producing prostration, anemia, and collapse, the diagnosis is easily made.

Prognosis.—Except in very young infants the patient rarely dies during the first hemorrhage. The longer a "bleeder" survives, the greater is his chance of outliving the tendency to bleed. In the very young when there are symptoms which suggest continuous bleeding, anemia, and a tendency to collapse, the prognosis is very bad.

Pathology.—Nothing except the anemic condition is found in the viscera upon post-mortem examination. An unusual thinness of the blood-vessels has been noticed.

Treatment.—The principal indications are to check the hemorrhage and to support the strength of the child: to this end the extremities of the child should be kept warm, and if ice is used as a local hemostatic, it should cover but a small surface, for the tendency to reduced temperature and collapse is very great. Among the remedies which promise the best results are ergot, preparations of iron, gallic acid, and aromatic sulphuric acid.

Hemorrhage from the Female Genital Organs.—It happens, very rarely, that there is a slight oozing of blood from the vagina during the first few days of the infant's life.

Etiology.—In all probability this slight hemorrhage is due to the congested condition of the pelvic organs. The sudden cessation of the flow of blood through the umbilical arteries may also contribute to this result. It is claimed by some authors that menstruation may occur in the new-born. Cullingworth collected 32 cases of menstruation in young infants.

Symptoms and Treatment.—The *symptoms* are simply a slight oozing of

blood, which can be differentiated by an examination of the parts. A red stain, often produced during the first days of infancy by the escape of uric acid or urates, must not be mistaken for this form of hemorrhage. If the hemorrhage is slight and unassociated with the hemorrhagic diathesis, no *treatment* will be required.

Gastro-intestinal Hemorrhage (Melena).—By this term is meant an escape of a variable amount of blood, usually from the bowels, but occasionally vomited, during the first few days of infant life. The amount of blood lost and the symptoms that follow in this disease range all the way from a slight and harmless hemorrhage with no general symptoms to a loss of blood so great that the death of the child is imminent. This form has been spoken of by some authorities as the "black disease," and by others as "melena." We recognize three classes or varieties of gastro-intestinal hemorrhage:

First, the unimportant class due to very slight congestion or abrasion in the integrity of the lower bowel. Thrombosis of the umbilical blood-vessels has been thought to increase the congested and hyperemic condition of the gastro-intestinal canal, which condition always exists immediately after birth. Asphyxia is another predisposing cause. Blood in considerable quantities may flow from a fissured or excoriated nipple of the mother and be swallowed by the nursing child, and make its appearance either as moderately bright, fresh blood in the vomited material or very much changed in color and consistence if it is mixed with excreted matter from the bowel. This discharge must not be mistaken for hemorrhage coming from the child.

The second class is somewhat more grave: it is caused by deep erosions or ulceration in the gastro-intestinal tract or by the perforating round ulcer of the stomach.

The third variety is caused by constitutional diseases present in the new-born, such as hemorrhagic diathesis, syphilis, various forms of sepsis, the hemorrhagic eruptive diseases, and fatty degenerations.

The second and third classes constitute melena proper, which is rare. According to Buhl and Hecker, 8 cases occur in 4000 births; according to Spiegelberg, 2 in 5000; according to Genrich, 1 in 2800 (Unger). The unimportant or simple variety of hemorrhage occurs somewhat more frequently.

Symptoms.—The blood usually begins to flow about the second day; sometimes it is vomited, at other times it comes from the bowel. If the blood is vomited, its color may not perceptibly be changed, but if it is discharged from the bowel, it is usually dark, mixed with meconium, which is apparently more profuse than usual. In the course of twenty-four hours, if the hemorrhage continues, the child begins to fail and becomes pale, cold, and indifferent; the pulse is small and rapid; respiration is very frequent; the child is in collapse, and death occurs in a few hours.

Prognosis.—The prognosis depends largely upon the etiology. In the first variety of gastro-intestinal vomiting the prognosis is good; in the second and third varieties it is always grave. The mortality of true melena, as stated by

different authors, is from 30 to 70 per cent. The prognosis becomes especially grave if the hemorrhage lasts more than forty-eight hours.

Diagnosis.—Look carefully for local causes, and then for some constitutional defect. Slight hemorrhage with trismus should cause one to look for intussusception. If the blood is vomited and fresh and the child has no symptoms of depression, it may have come from the mother's nipple, from the child's tongue, or from some part of the upper digestive tract or respiratory apparatus. If it is from the bowel, and evidences of cyanosis or jaundice or depression soon follow, in all probability some general disease is the cause.

The pathology varies with the cause. In true melena the tissues are usually pale and anemic. Ecchymoses upon the different membranes, and occasionally eroded blood-vessels, may be seen, or there may be found evidences of the severe general diseases referred to on the previous page.

Treatment.—About the same line of treatment is indicated here as that for the hemorrhagic diathesis. In the first variety of hemorrhage the treatment consists in giving attention to the existing local cause. In true melena, if mild, the internal use of astringents may be of value; in addition to this, the treatment is directed to the supposed cause, while every effort is made to support the strength of the child. In severe cases all therapeutic measures are powerless.

Colic and Diarrhea.—*Colic* is a very frequent cause of suffering in infants; even during the first days of life intestinal colic will be brought about by an irritation of the sensory nerves of the alimentary canal: this irritation may be due either to the abnormal properties of the digestive products or to imperfect processes of fermentation, leading to excessive formation of intestinal gas; also to the irritation produced by accumulation of fecal matter and to the delayed expulsion of meconium. In other words, the irritation may be either chemical or mechanical. In both instances the first cause is usually due to improper food. In the young, reflexes are especially easily excited. An infant nursed at the breast will suffer from imperfect digestion and from abnormal formation of gas if the breast-milk contains a considerable amount of colostrum, and also if nursed by a wet-nurse whose milk is unsuitable because of disparity in age between her own and the child she is nursing. All artificial foods, especially the amylaceous group, predispose to flatulence. Constipation, whether due to imperfect diet or to some stenosis in the alimentary tract, will give rise to distention and irritation, producing severe forms of colic.

The symptoms of colic are sudden attacks of pain, manifested by the infant refusing to nurse, by its restlessness, and by contraction of the limbs and of the abdominal muscles. After the expulsion of gas the symptoms will disappear as suddenly as they came.

The treatment during the attack consists of the application of dry heat and gentle friction in the course of the colon. Should the attack be severe, a warm bath will afford the greatest relief. The introduction of a soft catheter

into the rectum will favor expulsion of the gas, and may be followed by an enema of oil or of warm water.

The food must carefully be investigated, and if found at fault it must be changed for one more suitable. In acidity of the vomited matter or of the stools small doses of calomel combined with alkalies will be of benefit; aromatic teas will relieve by favoring the expulsion of gas. Among medicines usually found efficient are grain doses of pepsin, 2 to 5 drops of gin or whiskey in hot water, drachm doses of hot soda-mint, or the milk of asafetida administered by the mouth (10 to 20 drops) or by the bowel. The habitual use of paregoric for this trouble is to be condemned.

Diarrhea.—During the first few days after the birth the stools of the infant are a dark brown or greenish mass called "meconium." This substance is very tenacious, consisting of fatty matters, epithelial cells, biliary pigments, and cholesterin. It is really an accumulation in the small intestines of bile which collected during fetal life. After the third day the meconium has passed, and is substituted by yellowish, semi-liquid stools. Under normal conditions the new-born infant has three or four stools a day. In infants, on account of the pasty condition of the intestinal matter, more or less excrementitious material will collect in the rectum, which fact explains in some degree the number of daily evacuations from the bowel of infants in health. What, then, constitutes diarrhea in infants? This question can only be decided by observing the character of the passages and noting the growth of the child. One evacuation each day in some cases may be sufficient, but frequently where this is the habit some of the deleterious results of constipation will be observed. Nevertheless, we have frequently noted three or four movements each day, and have found by actual weight of the child a normal increase from week to week, with every indication of good development. From one to four passages each day, then, would be regarded as normal. Deviations from the normal number occur, such as evacuation every time the napkin is changed. Idiopathic diarrhea may occur during the first week. It is usually due to bad hygienic surroundings, to foul air, and to improper food. Sudden changes of temperature are very apt to produce diarrhea.

The treatment of diarrhea, like that of colic, is based on the same principles as that for the same derangement in older children, the selection of proper food being the principal element of treatment. Small doses of calomel (gr. $\frac{1}{20}$ to gr. $\frac{1}{4}$) two or three times a day will correct the fermentation. If this drug does not correct the trouble, from 1 to 3 grains of subnitrate of bismuth and 2 to 4 drops of aromatic sulphuric acid may be added to check too frequent stools.

Constipation.—Constipation is very common even in the very young; it may be a symptom of various pathological conditions. In children the intestine is relatively longer and its calibre smaller than in adults; the walls are thinner and weaker. The ascending and transverse colon is shorter, and possibly flexures are formed because of pressure from above by the liver, which is relatively larger in a child; also by the relatively contracted condition of the pelvis. These anatomical peculiarities give less space to the intestinal tract,

and in some cases they represent etiological factors in causing constipation. The peristaltic movement in babies is slight because of imperfectly developed muscular structure. As the child develops peristaltic action and muscular tone are increased. Another anatomical peculiarity in the lower bowel is the deep cul-de-sac which the sigmoid flexure forms before it joins the rectum. This pouch predisposes to fecal accumulations. Gerhardt denies the existence of so marked a curve in the sigmoid flexure.

In the healthy child the mother's milk is mostly absorbed and assimilated, leaving but a small amount of residue; the amount of material evacuated has some relation to the amount taken into the system. The albumin of the milk is nearly all digested in the stomach and bowels of the child, and from this very process we have a physiological cause for constipation, fecal matter existing in such small amount that intestinal peristalsis is not excited. Habitual constipation in the mother may be a predisposing cause of constipation in the infant. Other causes are deficient intestinal secretion, excessive perspiration, medicines, herniæ, intestinal obstruction, congenital malformations, chronic peritonitis. Constipation occurs also in meningitis, in myelitis, in hydrocephalus, and in microcephalic conditions and other diseases of the cerebro-spinal system.

What has been said above under the head of *Diarrhea* concerning the number of normal passages in an infant applies also to constipation. From one to four passages a day may be considered normal, providing the child does not suffer. A steady increase in the weight and the general good condition of nutrition will aid one to decide whether the number of passages is sufficient. Constipation is undoubtedly more frequent in adults than in children. In all probability, what are called "family peculiarities" are due more to the neglect of the proper attention to the wants and habits of children.

Treatment.—In the nursling the use of drugs should usually be discarded. After excluding congenital defects, we should look to the mother for the cause; also to the child's diet. Artificial foods, including condensed milk, in many instances produce diarrhea, but in other cases they give rise to constipation; any food which is absorbed quickly, leaving little or no residue, will produce this condition. To obviate this effect, if water has been used as the diluent, oatmeal-water should be substituted. The effect of local stimulants, such as introducing soap or glycerin suppositories into the rectum, should be tried. Whenever the colon is blocked up it must be cleared by the use of an enema. Glycerin may be administered in the form of an enema (30 to 60 drops, diluted with a little water). Large injections of fluid (more than 2 to 4 ounces) should be avoided; they produce over-distention and paresis.

Intestinal Obstruction.—Most cases of intestinal obstruction in the young infant are due to congenital malformations, either from arrest of development or from the effects of fetal peritonitis. Volvulus or intussusception may cause obstruction.

The symptoms of obstruction are constipation, colic, intense pain, often distention of the bowel. There is no escape of flatus; sometimes there is a

discharge from the rectum of mucus and blood. In volvulus the symptoms usually occur suddenly.

The diagnosis is not always easy. In cases of complete obstruction the child does not pass meconium. Soon after being put to the breast it begins to vomit, first the contents of the stomach, then bile, later meconium. The abdomen soon becomes distended. Death occurs in a few hours or days. In some cases the anus is absent. If the external opening is present, a malformation of the rectum is apt to be overlooked and the case diagnosed as simple constipation. In these cases purgatives only increase the difficulty. The child suffers much pain, cries almost constantly, the abdomen is greatly distended, vomiting and symptoms of collapse appear, and death from exhaustion finally occurs. If digital examination is made, the finger will pass but a short distance. If there be only a membranous septum, the bulging of the gut from above can distinctly be felt. When the anus is absent and the rectum ends just above it (which is the commonest condition), bulging of the lower end of the rectum may be felt, but if the rectum ends higher up, this will not be observed.

Treatment.—Many infants with obstruction of the bowel are either stillborn or they live but a short time. Surgical measures must be resorted to soon after birth. When there is only a thin septum between the rectum and the gut, a crucial incision and dilatation with the finger will be all that is required. The mucous membrane should be stitched to the skin. If the separation between the rectum and the surface is greater, the bulging of the distended gut must carefully be looked for, and if it is found incision should be made in front of the coccyx and be carried down until the bowel is reached. The bowel should then be opened, drawn down, and stitched to the skin. If the gut cannot be found below by dissection, then an operation from above should be undertaken. Littre's operation of opening the colon through the groin, or Amussat's lumbar operation, must be performed. The opening of the peritoneal cavity should be attended with the usual aseptic precautions. The steps in the operation are practically the same as those in the case of an adult.

Lamphear reports a case of absence of the upper rectum in which the following operation was performed, apparently with success: "An incision was made through the sphincter to the coccyx, and dissection was made through the connective tissue to near the promontory of the sacrum. A small sound was inserted into the bladder as a guide. After dissecting upward for about an inch and a half, the peritoneum was reached. This was cut into, the sigmoid flexure of the colon easily pulled down and stitched to the upper end of the rectum, an opening three-quarters of an inch being made in the side of the bowel, with the discharge of an immense amount of feces. There has been no fever and no peritonitis, and the child is well and growing nicely."

In cases where fecal matter has been passed by the rectum and there are suddenly-developed symptoms of obstruction, volvulus is likely to be the cause. If the administration of laxatives (castor oil) and enemas has failed, then it is necessary to resort to abdominal section both for diagnosis and for relief.

Sometimes during infancy (most frequently between the ages of four and six months) a portion of an intestine passes into another.

Inguinal and Umbilical Hernia.—In infants the inguinal canal is straight and short, and in delicate male children a hernial protrusion including a loop of intestine is not uncommon. Most of these cases may be cured by the wearing by the child of a properly-fitting truss for several months or years. Umbilical hernia may be acquired in poorly-developed children when there is a large cord; the hernial sac will sometimes contain small intestine and peritoneum. A compress or a disk of metal or hard rubber larger than the protrusion should be made, and held in position by means of a bandage; knitted bandages are most comfortable and useful.

Peritoneal abscess rarely occurs in early infancy. One case is reported in which the abscess was due to caseous mesenteric glands (Ashby and Wright).

Disturbances of the Urinary Organs.—Infants frequently pass with the urine considerable uric acid, which forms a visible deposit on the napkin. This passage of uric acid may be unaccompanied by any discomfort; again, it may cause disturbance in micturition, or even convulsive seizures and pain. The *treatment* consists in administering small doses of citrate of potash and sweet spirits of nitre.

The malformations described on page 354, Vol. I., are also accompanied by various disturbances of the urinary function. Opening of the rectum into the urethra or the bladder is evidenced by the passing of fluid feces and gas through the urethra, or in the female it may pass through the vestibule. Later, vesical irritation caused by the decomposing urine may take place. The health of the patient is not always interfered with. Contraction of the urethra may give rise to incontinence or retention of urine. In these cases catheterization will give temporary relief. Dilatation may become necessary.

Phimosis, or elongation and contraction of the prepuce, often gives rise to nervous disturbance and to painful micturition, or even to convulsions.

Treatment for Phimosis.—If phimosis occurs only in a slight degree, daily retraction and cleanliness for a week or two usually overcome the difficulty. Even when the prepuce is very tight and adherent to the glans penis, it is usually sufficient immediately or soon after birth to separate the adherent surfaces with the flat end of a probe, followed by thorough dilatation of the prepuce with dressing-forceps. The foreskin should thereafter daily be retracted, cleansed, and a film of cotton covered with borated vaselin should be laid over the glans penis before allowing the prepuce to recover the glans. If the phimosis gives rise to secondary derangements, such as irritation, incontinence, or retention of urine, hernia, prolapse of the rectum, and more severe reflex nervous troubles, circumcision should be performed early should the above-mentioned plan of treatment fail.

Hypospadias, epispadias, and *extroversion of the bladder* will cause incontinence of urine and excoriation. Operations for these conditions are the only means of relief; they are usually delayed until after the child is one year old, and are not always successful.

6. Hygiene and Therapeutics soon after Birth.

1. Hygiene.—Care immediately after Birth.—The air-passages should be cleared of mucus by inverting the child and brushing away the mucus with the finger. When the infant has cried lustily and the cord has been severed, the little one should be wrapped in a warm flannel receiving-blanket. The eyes and navel should immediately be cleansed with sterilized water and be washed by a 3 per cent. solution of boric acid; after that the nurse may proceed at once to cleanse its body. For this purpose the bath is not always advisable. Very feeble children are easily chilled, and in these the water-bath at first is to be avoided; instead of the bath the body may be anointed with olive oil or with plain vaselin, which is removed with absorbent cotton. Vigorous rubbing of the skin should be prohibited. The room should be warm. The child should be bathed every day with oil or with water. The dressing of the cord has been fully described on page 353. Before clothing the child a careful examination must be made to detect any existing malformation or defect, and finally the cord must be examined to see that there is no bleeding.

From the first the infant is to have its own crib, which may be placed near the mother's bed or in the adjoining room if a special nurse can be provided. This room should be aired regularly night and morning. During the first few days laying the baby on its right side will favor closure of the foramen ovale.

Food.—As soon as the baby has been cleansed and the mother has been cared for and rested, the child should be placed to the mother's breast; this being done both to satisfy the natural instinct of the child and for the benefit derived by the mother from the reflex contraction produced in the uterus. The first secretions of the breast will usually supply sufficient nourishment, and their laxative quality is beneficial to the child. In the course of from thirty-six to seventy hours the secretion of milk should be established. It is essential that from the beginning the child should acquire regular habits of feeding, and for this reason it should be applied to the breast at regular intervals—for the first month every two hours during the day and two or three times during the night. Before placing the child to the breast the nipple should be washed with sterilized water, and again after nursing. The importance of giving proper attention to feeding babies cannot be over-estimated.

Infant mortality is very great; up to the fifth year about 25 per cent. of babies die. One author shows that out of 1940 deaths of infants, only sixty-one were nursing at the breast.

The rapid development of infants involves rapid tissue-change and necessitates constant and sufficient supply to all the structures. Well-fed babies are usually quiet and give comparatively little trouble, and they are usually exempt from disease; while poorly-nourished babies are fretful and are particularly liable to have convulsions.

No artificial food can take the place of the mother's milk; nursing infants

usually thrive well; but, unfortunately, many mothers, especially in the favored class of society, are unable to provide this milk. Again, many who can are unwilling to do so. A wet-nurse is the best substitute next to that of properly prepared cow's milk. Mixed food is likely to cause diarrhea. The details of artificial feeding have been discussed on page 181.

2. Therapeutics and Dosage.—The following are some of the remedies most commonly required in early infancy:

A. External Remedies.—*Antiseptics.*—The stronger remedies in this group must be used with caution, as infants are very susceptible to their toxic effects; this is especially true of iodoform and of carbolic acid. Salicylic acid and boracic acid are to be preferred. The former may be diluted with starch (1 : 3 or 1 : 5). Bichlorid of mercury is used in solution of 1 : 5000 to 1 : 10,000.

Protectives.—Boric acid and lycopodium or borated talcum powder constitute an excellent baby powder. If there is much chafing, subnitrate of bismuth and starch (1 : 5) may be substituted. Simple cerate is also efficient for chafing. Oiled silk is used to protect the skin from cold, to favor perspiration, and as a protective in swelling.

Astringents.—The formulæ of salicylic acid and boric acid, referred to above, are excellent astringents.

Counter-irritants in early infancy must be used with care. Babies do not bear blisters well. In colic a spice poultice is a good counter-irritant.

Heat and Cold.—Care must be observed in applying heat and cold. A warm bath is a good nerve-sedative and often reduces temperature. Warm fomentations may be used on the chest and the abdomen, but they are often dangerous when applied to the head. Ice applied to the head must be used with caution.

B. Internal Remedies.—*Nutrients and Tonics.*—When additional nutrition is required, peptonoids, beef extracts, and cod-liver oil are beneficial; the latter may be used by inunction. Among tonics, the syrup of the iodid of iron may be given in drop doses, two or three times a day.

Digestives, antiferments, and antacids are usually required only by babies who are fed artificially. Administering these agents in hot water adds to their efficiency. Pepsin given in grain doses will aid digestion. Aromatics, such as peppermint and anise, are given in the form of an infusion. Salicylate of bismuth, calcined magnesia, and charcoal are also efficient antacids. Calomel, $\frac{1}{12}$ to $\frac{1}{4}$ of a grain, is very efficient in fermentation of food.

Laxatives.—Constipation usually depends on dietetic errors which should be corrected before drugs are given. The addition of sodium, of sugar, or of both, to the food will often correct the trouble. Among drugs, castor oil, from 15 to 30 drops, is the best laxative. Calcined magnesia, from 8 to 10 grains, is excellent where there is acidity or flatulence. For chronic constipation the fluid extract of cascara sagrada (5 to 30 drops) or compound licorice powder ($\frac{1}{4}$ teaspoonful) may be used occasionally.

Stimulants are especially indicated in the prematurely born and in any con-

dition in which the circulation is impaired and the vitality is low. Among alcoholic stimulants whiskey is the best: 1, 2, or 3 drops may be given every hour. Alcohol is especially indicated in septic diseases, in which it is borne in much larger doses. Carbonate of ammonia, ½ to 1 grain, and tincture of digitalis, ½ minim, every hour, are excellent cardiac stimulants.

Antipyretics are not often indicated; when the temperature is high, it is best to reduce it by the use of the bath.

Antispasmodics in early infancy are required usually for colic, in which case the antiferments may be given; in addition the milk of asafetida in from 15- to 30-drop doses is excellent.

Nerve-sedatives are not often required, and should, as a rule, be avoided. The irritation and pain may usually be relieved by removing the cause; this applies especially to faulty diet and its sequences. When opiates are unavoidable, paregoric may be given in from 2- to 5-drop doses.

Alteratives are especially indicated in hereditary syphilitic disease, and in this case they should be continued for a long time. If the baby nurses from its mother, both should be under treatment. Mercurials are well borne in early infancy. Calomel ½ grain, or gray powder ½ grain, may be given by the mouth, or the oleate of mercury may be used by inunction.

Mercurial ointment, ½ drachm, mixed with equal parts of vaselin if applied to the body of the child from axilla to pubes, and covered by an armless, snug-fitting flannel jacket, makes a good permanent medicating medium. This binder may be retained day and night until it becomes soiled or worn, when it should be replaced by a new one similarly medicated. For onychia, bullæ, or fissures due to syphilis, the protiodid of mercury may be used.

Diuretics.—Before administering a diuretic a careful examination should be made to exclude the existence of congenital obstruction. Diuretics are occasionally required during the first days, when the urine is deficient and where there is much deposit of urates or of uric acid. Sweet spirits of nitre, 5 drops, combined with citrate of potash, ¼ to ½ grain, may be given two or three times a day.

Hemostatics are required with the hemorrhagic diathesis and in sepsis, melena, etc. Fluid extract of ergot, from 1 to 3 drops, gallic acid, 1 to 2 grains, and cracked ice are the most useful; but ice must be used with caution when the vitality is low.

7. Premature Infants.

By a "premature infant" is meant one that is born between the period of viability and the natural end of pregnancy, whether the interruption of pregnancy be spontaneous or be induced. The exact period of viability cannot be fixed upon accurately in any given case, for the period may vary within relatively wide limits. In this respect much depends upon the nourishment of the fetus prior to its birth, the condition of the mother during pregnancy, the conditions necessitating or leading up to the interruption of pregnancy, the duration of, and complications and difficulties attendant upon, labor, as well

as upon the nature of the surroundings and the ability of those interested properly to care for the child. It has been customary to fix the period of viability at twenty-eight weeks. As a number of premature infants of twenty-four weeks have successfully been raised, the suggestion that any child that breathes at birth be treated as viable should be adopted in place of any fixed rule based upon the age of the fetus or upon its size.

To preserve the life of the premature infant to a time corresponding to what would have been the normal completion of pregnancy it is important that there be observed certain essentials in its care and management. This necessitates that we pay especial attention to—

First, the maintenance of the bodily temperature.

Second, the prevention of exhaustion.

Third, the administration of the proper amount and kind of nourishment.

The nearer to the end of full term the child is born, other things being equal, the more favorable are the chances for preserving its life, under proper care, to what would be the natural time. If it has been thus preserved and it has increased sufficiently in weight and strength, its chances for life then are the same as that of a child born at full term.

The Maintenance of the Bodily Temperature.—The vital organs of the premature infant have not developed sufficiently to maintain a uniform body-heat independently of other means. During intra-uterine life the fetus is surrounded by a fluid of a uniform temperature, and the heat of the blood is regulated by means of the placental circulation. We can best imitate these methods of nature by surrounding the child's body with a suitable non-conducting material kept constantly at an even temperature, and by furnishing to the child a plentiful supply of pure air that is also of a certain definite and uniform temperature.

This condition, the maintenance of the bodily temperature, is best met by the use of an incubator or *couveuse*. There are several patterns of incubators, notably those of Tarnier, of Auvard, and of Credé, which have been used with especial success in the maternity hospitals of France and Germany. They are more or less complicated and expensive structures, and, while of the greatest utility in hospitals and among the wealthy, they would often be impracticable in private practice, especially among the poor and in towns remote from a metropolis. Credé's incubator consists essentially of a double-walled copper tub. The space between the walls is filled every four hours with water at a temperature of 122° F. The tub is half filled with cotton-wool, upon which the child is placed, undressed, with absorbent cotton about its genitals. The tub is then filled with cotton-wool, with the exception of a space for the child's face.

The "Ideal" incubator (Figs. 162, 163) is a recent and satisfactory apparatus. It is constructed of steel with glass doors, and one glass window on the side for feeding purposes, etc. The heat generated in *c* communicates itself to the water-filled tubes *e* on the inside, maintaining a uniform temperature at any desired point by means of a thermo-regulator inside, which

is controlled by micrometer adjustment from outside. The hygrometer records the atmospheric conditions of the chamber. The air supplied to the infant is filtered through an absorbent cotton filter in the box *a*; this air can be taken from the room in which the apparatus is placed, or can be obtained directly from the outside by means of tubes. The revolving wheel (*m*) in the chimney indicates the perfect circulation of air.

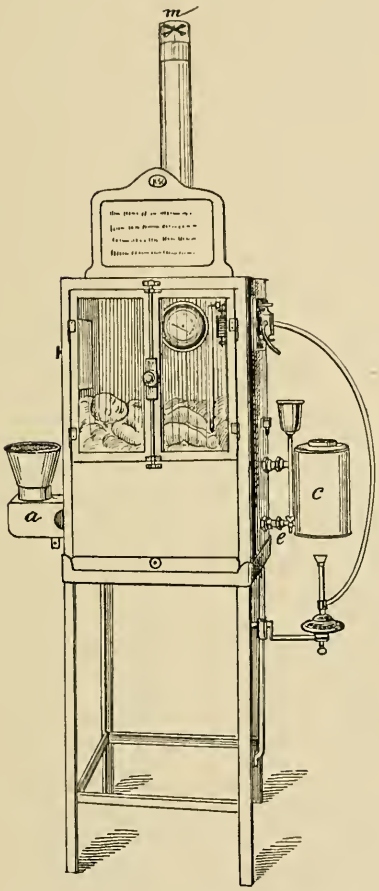


FIG. 162.—"Ideal" incubator, manufactured by the Kny-Scheerer Co., New York.

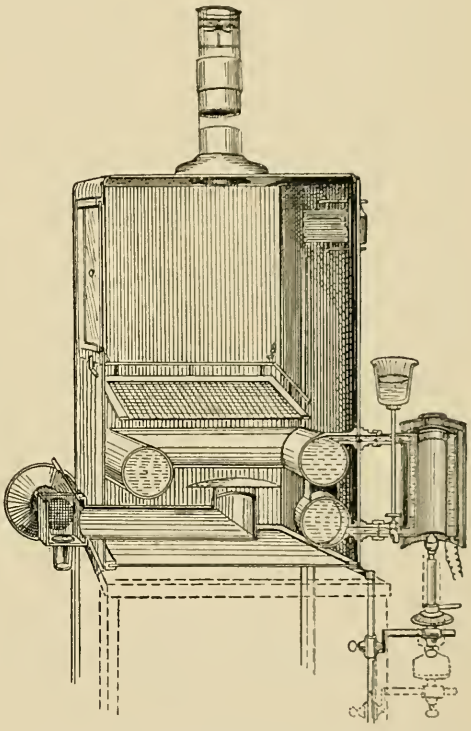


FIG. 163.—Sectional view of the "Ideal" incubator.

An extemporized incubator may be made in any home with easily procured materials that will answer the purpose of the more elaborate manufactured article very well. A large-sized market-basket, a small-sized clothes-basket, or an ordinary wooden box is first lined with heavy wrapping paper, and is then thoroughly padded with blankets or cotton batting, or both. Half of the basket or the box is then filled with some soft, non-conducting material, such as cotton-wool or cotton batting. Hot-water bottles or hot-water bags are to be so arranged about the sides of this receptacle that one or more may be removed or exchanged without exposing or in any way

disturbing the child. The child, having been thoroughly anointed with warm sweet oil, is placed in this receptacle undressed, with an absorbent pad arranged for the collection of feces and urine. The incubator is then filled with cotton-wool or cotton batting, the child, with the exception of its head, being completely covered. If necessary, an additional shawl or blanket may be thrown over the incubator, care being taken that none of the weight be borne by the infant. A thermometer should be put alongside the child, and the temperature should be kept between 87° and 92° F. The air of the room in which the incubator is to remain should be kept pure and at a uniform temperature of about 71° F. Constant attention by day and by night is essential to the proper regulation of the temperature of the incubator.

The Prevention of Exhaustion.—After the child is placed in the incubator it should be disturbed as little as possible, as all movement, whether passive or active, requires on the part of the infant more or less expenditure of vital force. For this reason, and for the additional reason that exposure will rob it of body-heat, the child should be bathed not oftener than once a day, and then with warm sweet oil, and this bath should be given with as little exposure and handling as possible. The absorbent pads arranged about the genitals should be changed sufficiently often to ensure cleanliness, but this change should also be made gently and without exposure. Another source of exhaustion would be the muscular effort required in sucking if the child were put to the breast or if it were required to nurse from a bottle, so that some other method of nourishing the infant should be adopted.

The Administration of Nourishment.—The premature infant should receive at stated intervals a definite amount of nourishment, the quantity and frequency of its administration depending somewhat upon its age and upon the indications arising from time to time. If for any reason the mother's milk cannot be used and a suitable wet-nurse cannot be obtained, the child's nourishment should consist of cow's milk, properly sterilized and diluted and otherwise modified to suit the age and condition of the infant. The greatest care should be observed in the preparation of the nourishment, whether it be taken from the breast or be prepared from cow's milk, and in its administration, so that the child will receive it free from germs. Milk may be given from the beginning, or the child may receive during the first day from 10 to 20 minims of warm water, containing 2 minims of whisky, every one or two hours. From 1 to 2 drachms of warm nourishment should be given every hour at first, the amount and the interval being very gradually increased after the child shows evidence of increasing weight and strength. In the administration of the nourishment one of the following methods may be chosen.

The simpler procedure, and the one most practicable for ordinary cases in private practice, consists in introducing the food, a few drops at a time, into the back part of the mouth or pharynx by means of an ordinary medicine-dropper or small glass piston syringe. When breast-milk is available, the mother's or the nurse's breast should gently be stroked with the finger-tips until the milk flows freely, when, by means of a breast-pump, 2 or 3 drams

of milk are withdrawn and placed in a warmed and clean receptacle, from which the amount of food required is immediately given to the infant.

The second method is known as *gavage*. The infant is placed horizontally on the nurse's lap, with head slightly raised. A No. 14 or 16 (French) soft-rubber urethral catheter, thoroughly sterilized, is first anointed with a little of the food to be given. The end is introduced into the pharynx, and from there, as the child swallows, it is gently passed on into the stomach. When the catheter has been introduced 15 centimeters (6 inches) its tip has entered the stomach. From a small glass funnel or syringe inserted into the outer extremity of the tube the milk fresh from the breast or the artificial food warmed to a temperature of 95° F. (35° C.) is allowed to pass slowly into the stomach. In withdrawing the tube it should be done with a rather quick motion, in order to prevent the milk from following it. Rapid withdrawal of the catheter is facilitated by placing the forefinger of the left hand upon the tongue and depressing it. If the presence of the tube causes no inconvenience, it may be left *in situ* over several feedings, being removed two or three times a day for the purpose of cleaning it. After the child gains strength, and when its power to suck is sufficient, it may be given the breast several times a day, gavage and nursing being thus alternated until nutrition is well established.

The carrying out of these several essentials in the proper care and management of the premature infant requires the most patient and careful attention on the part of the nurse. The temperature of the incubator will require close attention to prevent too high or too low degree of heat. The cleanliness of the child and of the appliances used at each feeding is also an important detail. The slightest neglect in any particular is apt to prove disastrous to our efforts. While this is especially true as regards the child born between the twenty-fourth and the thirtieth week, the child born later than this should not therefore be in any way neglected. If the eight months' children were treated, for a time at least, exactly as are those of seven months, more of them would be saved.

The following statistics show what has been accomplished by incubation and gavage: Of infants born at the sixth month, 22 per cent. survived; at the seventh month, 38 per cent.; at the eighth month, 89 per cent.; at eight and one-half months, 95 per cent. The probability of rearing a prematurely-born infant after the period for incubation and gavage has passed is largely dependent upon the care exercised throughout the first year or two of life. Children born prematurely to parents in good circumstances will very often survive infancy, while the infants of the poor not infrequently succumb to intercurrent disease.

VI. OBSTETRIC SURGERY.

I. Instrumental Operations.

General Requirements and Preparations for Operations.—Most of the bad results following obstetrical operations are due to the carelessness rather than to the ignorance or inexpertness of the operator. Though most physicians feel that in the practice of medicine and surgery they must be painstaking, methodical, and familiar with recent advances in knowledge, yet in obstetrical work they are apt to be careless and indifferent, trusting that *nature* will supplement all deficiencies and somehow pull the patient safely through. Many who pride themselves upon their scientific precision as physicians or upon their expertness and rigidity of technique as surgeons are nevertheless slovenly and careless as obstetricians. This anomalous state of affairs may be due to the wide diffusion of the erroneous idea that pregnancy is a physiological process whose natural termination is labor, and that consequently no special care or precaution is necessary. "Meddlesome midwifery is bad" is a half-truth which has done much harm, cramping scientific effort and serving as an ever-ready excuse for the delays and procrastinations of incompetence and ignorance. Obstetricians can never do good, safe work until they learn to regard *every* confinement as a surgical case with many pathological possibilities to be avoided or to be overcome, rather than as the natural termination of a physiological process. Operative midwifery is a department of surgery governed by the principles and rules of surgery. Operative precision cannot be attained, nor can mortality and morbidity be reduced to the utmost, unless practice is based upon broad surgical principles, and the same attention is paid to technique as in operations upon other parts of the body. In the main, modern surgery owes its success to the observance of a rigid antisepsis. Surgical cleanliness is imperative in even the smallest operations if the best results are to be obtained. In no department is this more important than in operative obstetrics, and in none does disaster follow carelessness and neglect more speedily and surely. It cannot therefore be too strongly impressed upon all who practise the obstetric art that *a rigid technique is essential*, and that success or failure will depend more upon surgical cleanliness than upon mere expertness in operating. Septic micro-organisms do not normally exist in the uterus nor in the upper part of the vagina; they are not formed *de novo* in the parturient canal, but must be introduced from without. Indeed, the micro-organisms which do exist in the vagina seem to be part of nature's line of defence against invaders from without. The doctrine of *autoinfection* as commonly expounded, if allowed to

influence our rules of practice, can do nothing but harm, and therefore cannot too severely be condemned. The man who believes that a patient can generate in her own body septic matters *de novo*, and can thereby infect herself notwithstanding rigid antiseptic precautions, will sooner or later relax those precautions, and have ready to hand a salve for his conscience when septicemia does arise; but the one who makes it his working hypothesis that septicemia always arises from infection introduced from without as the result of some failure in technique will be stimulated to watch his methods with ever-increasing care, seeking for the weak points in his defence and profiting by his errors and failures. It has well and truly been said that the doctrine of autoinfection is the gospel of despair and tends to paralyze honest effort.

In obstetrical as in all other operations it is of prime importance to see that the field of operation and everything coming in contact therewith (hands, instruments, dressings, etc.) are thoroughly aseptic, and are kept so throughout the operation and as much as possible during convalescence. This is perhaps harder to do in obstetrical than in general surgical work, on account of the anatomical arrangement of the parts and the difficulty and inconveniences under which operations must be performed. The external genitals and the vagina should receive special attention, being thoroughly scrubbed and washed with soap and hot water and then douched with a hot solution of some reliable disinfectant according to the circumstances of the case. Some use corrosive sublimate (1 : 1000, 1 : 2000, 1 : 4000); others prefer creolin, lysol, carbolic acid, permanganate of potash, etc. Good or bad results can be obtained with any of these agents, as more depends upon the thoroughness of the cleansing than upon the choice of the antiseptic. Plenty of hot boiled water is sufficient in most cases, with perhaps the addition of a little creolin. Lubricants are unnecessary and had better be avoided. Sponges are a fruitful source of trouble; a fairly good substitute can be made by sewing up rolls of absorbent cotton or of sterilized gauze of convenient size in a gauze covering; they can be sterilized just before operation and be destroyed afterward. Instruments are now made with metal handles, so arranged that they can easily be taken to pieces and cleaned. Sterilized sutures and ligatures are also readily obtainable, and there is no good reason why an obstetrician nowadays should ever use instruments or dressings which are not surgically clean. Great care should be taken with the hands and the nails, and precise directions should be given to the nurse as to the cleansing of the vulva and the perineum and the renewal of pads. These are all-important matters of detail, but they cannot here be discussed thoroughly. Different operators have different methods, but all have the same aim —the maintenance of surgical cleanliness. The tendency seems to be toward simplification of method; details may and do change, but principles never.

Passing the Catheter.—This little operation may be required during pregnancy, labor, or the puerperal period. During *pregnancy* two factors co-operate in causing retention of urine: (1) Mechanical disturbance of the natural relations, and (2) loss of tone in the muscular fibres of the bladder. During *labor* retention of urine from mechanical pressure is a common cause

of delay in the second stage, and emptying the distended bladder often removes the so-called "uterine inertia" and allows labor to proceed. During the *puerperium* retention frequently occurs from the sudden removal of intra-abdominal pressure. The uterus is smaller and the abdominal walls are laxer than before; the bladder, suddenly deprived of its wonted support from before and behind, is apt to distend and to be unable to empty itself.

Choice of Instrument.—A soft-rubber male catheter (No. 8, 10, or 12 English) is most suitable. Hard instruments of metal or of glass and the gum-elastic catheter with stylet are usually more readily rendered aseptic, but require very gentle manipulation.

Position of Patient.—The *dorsal* position, with limbs drawn up and *everted* so that the vestibule may be put upon the stretch, is preferable, because it brings the meatus within easy reach. The lateral position presents no special advantages and greatly impedes manipulation. It is better to see the parts than to attempt to catheterize *by touch* under the clothing.

Method.—The meatus is exposed and thoroughly cleansed with a pledget of cotton and an antiseptic solution. With two fingers of the left hand the labia are separated and the meatus is exposed to view. With the right hand the sterilized catheter, well lubricated, is passed through the meatus and pushed gently into the bladder, care being taken that no infective matter be carried from the urethral orifice.

During labor it may be difficult to get the catheter through the urethra into the bladder if the presenting part is wedged low down in the pelvis. The following maneuvres will generally suffice to overcome the difficulty: First: place two fingers of one hand upon the presenting part, and lift it up out of the pelvis as far as possible while the catheter is guided into the bladder with the other hand. It may be necessary to hold the presenting part away until the bladder is emptied. Second: should the first maneuvre fail, place the patient in the knee-chest position; the uterus and the presenting part will gravitate away from the pelvis, allowing the catheter to slip easily into the bladder. The latter method seldom fails unless the presenting part is too firmly wedged to be displaced. In the puerperal period considerable difficulty may be encountered during the first few days, especially in primiparæ. Edema or laceration of the parts may so distort the natural relations that the meatus may be drawn over to one side or even down under the anterior vaginal border. It is sometimes necessary to expose and draw up the vestibule before the displaced meatus can be found. When the catheter has been passed, one should make sure that the bladder is completely emptied by pressing upon the hypogastrium while the urine is flowing. The instrument must be perfectly clean; preferably a new one should be used for each case. If needed from day to day, the catheter should be cleansed thoroughly after use and be kept in a 2 per cent. solution of carbolic acid; before being used again it should be rinsed and washed with hot water to remove all traces of the acid, or an irritating urethritis or cystitis may be set up. It is important to have the vestibule freed from all discharges before the catheter is passed; to do this properly the labia should be well separated, the vestibule exposed, and a vulvar douche be given.

The Douche.—There are three kinds of douche, the *vulvar*, the *vaginal*, and the *uterine*. The first two are usually entrusted to the nurse; the last should be given by the physician.

Vulvar Douche.—As the vulvar cavity extends to the vaginal entrance, a vulvar douche should clean all that portion of the genital tract which lies anterior to the vagina. To do this properly the patient should be in the dorsal position, with the limbs everted and the labia separated with two fingers; the vulvar cavity can then easily be flushed out with an ordinary vulcanite or glass nozzle (straight or rose; Fig. 164) or by pouring water from a pitcher or a bottle, or it can be washed clean with jute or gauze pads, which can be destroyed. Unless properly instructed, nurses are very apt to wash over the *outside* of the vulva only, instead of cleansing the whole vulvar cavity.

Fig. 164.—Curved intra-uterine nozzle.

Vaginal Douche.—The vaginal douche may be given warm or hot, a cold douche rarely being required; it may be plain or medicated, the latter being required only in special cases. The patient should be in the dorsal position. If a large vaginal douche is required, she should be placed across the bed with the hips well over the edge, the thighs everted, and the feet resting upon a chair. A Kelly pad or a rubber sheet should be so arranged as to carry the

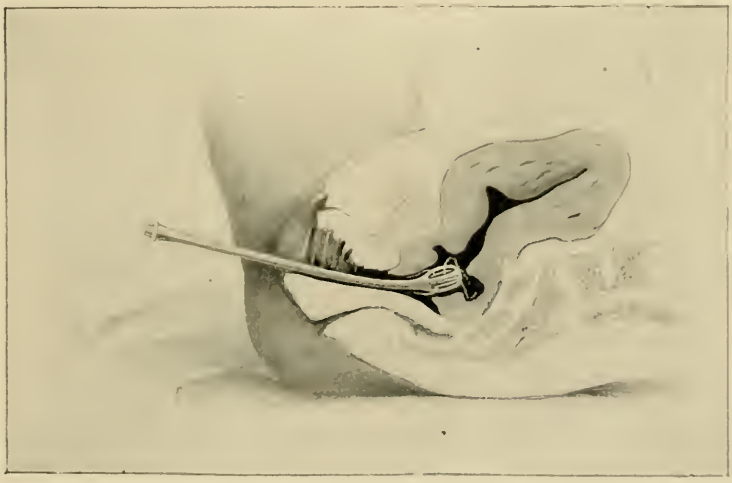


Fig. 165.—Intra-uterine nozzle, being almost straight and barely entering the cervix, is unable to flush out the uterine cavity.

water into a sufficiently large receptacle below. A vaginal douche during labor or the puerperium should be given in large quantity, the object being to convey a volume of water with but little force, cleansing the parts by the amount of fluid rather than by the force with which it is introduced. Nozzles are made of glass, of metal, or of vulcanite; they are straight or curved, with openings at the point or at the sides in the form of pinholes or of longitudinal eyes or slits. Glass nozzles are good, but they are fragile and must be handled with care;

metal is such a good conductor of heat that a very hot douche through a metal nozzle can hardly be borne; vulcanite is the best, but it is apt to lose its shape when boiled. The openings should be in the form of slits rather than pinholes,

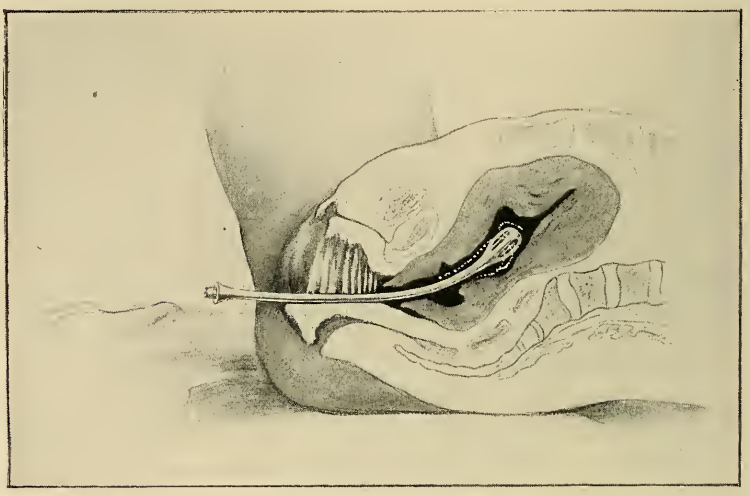


FIG. 166.—Intra-uterine nozzle passed into lower uterine segment, the uterine cavity not being satisfactorily flushed out; the perineal body is strongly depressed to elevate the tip of the tube.

and on the sides of the nozzle, never on the point. In giving a vaginal douche the practical point is to make sure of a sufficient outflow. The fluid should flow out as rapidly as it flows in, otherwise there will be ballooning and distention of the vaginal canal. Two fingers should be introduced into the

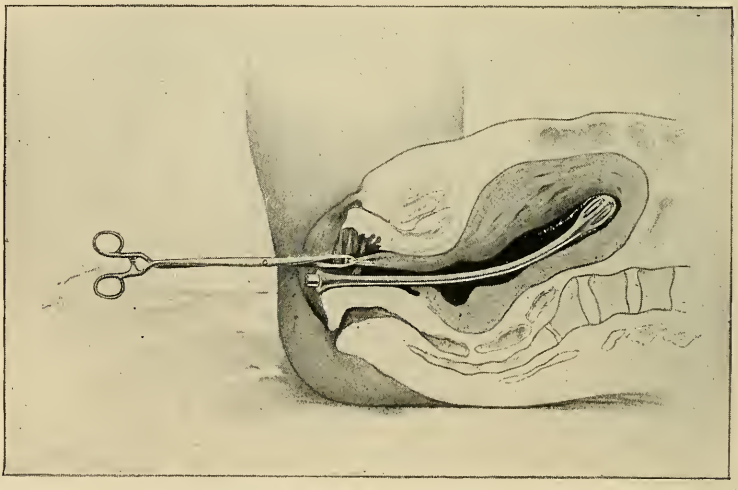


FIG. 167.—Anterior lip drawn down with volsella, and curved nozzle passed up to the fundus; whole uterine cavity being flushed from above downward.

vagina and be separated like a glove-stretcher; the nozzle is passed between the fingers, and a good outflow is thus maintained. Where the parts are roomy the same result may be obtained by pressing the nozzle firmly against

one side of the vagina. Double catheters are unnecessary; they are expensive, hard to keep clean, and do not give sufficient flow for obstetric work unless they are of extra large size. When the douche is finished the vagina should be emptied of fluid. If corrosive sublimate or other poisonous antiseptic has been employed, a pint or two of plain hot water should be run through to wash away or to dilute any fluid that may have remained in the vagina, thus diminishing the risk of absorption.

Uterine Douche.—The position of the patient and the general arrangements for the uterine douche should be the same as those for the vaginal douche. A large-sized inflexible nozzle of glass or of vulcanite with a pelvic curve should be selected. The delivery-tube should be of large calibre, in order to give a full-sized stream; the small tubes attached to the ordinary douche apparatus of the shops are useless for obstetric work. Objection is sometimes taken to the large-sized uterine nozzle, but, as a general rule, a uterus that needs douching easily admits the passage of a good-sized nozzle (Figs. 165–167). In the puerperal period the uterine douche is employed to flush out the uterine cavity and to remove débris, shreds, clots, and discharges. This removal can be effected thoroughly and satisfactorily only by discharging a large quantity of fluid at the fundus without force and by flushing the uterine cavity from above downward; the nozzle must therefore be carried up to the fundus. No difficulty will be found in passing the nozzle if the anterior lip of the cervix is seized with a pair of blunt bullet-forceps and drawn gently downward, so as to straighten the canal and to bring its axis more in line with the vagina. Care should be taken that tube and nozzle contain no air and that the vagina be washed out before the nozzle is passed into the uterus. The fundus should be supported by the hand while the douche is being given, and a good outflow should be secured to prevent distention of the uterine cavity. Slight traction upon the anterior lip will generally suffice to keep the cervix open and to allow the fluid to flow away freely. If sublimate has been employed, some plain hot water should be used as in the vaginal douche. When the nozzle is withdrawn the uterus should be made to expel any fluid that may remain before the bullet-forceps is removed.

The chief dangers of the uterine douche are that fluid or air may be forced into the Fallopian tubes and thence into the peritoneal cavity; or that clots may be dislodged from the placental site, causing hemorrhage or permitting the entrance of fluid or air into the sinuses; or that poisoning may result from the absorption of some of the antiseptic. Chill and rise of temperature often occur a few hours after a uterine douche, especially in nervous or debilitated patients. These unpleasant symptoms may be avoided or be minimized (1) by giving a stimulant a few minutes before the douche; (2) by having the injection-fluid *hot;* (3) by rapidity and gentleness; and (4) by so covering the patient that she is not exposed to chill while the douche is being given.

Curettage.—This operation is indicated (1) in cases of incomplete abortion when portions of the ovum or placenta are retained that cannot be removed by means of the finger or the ovum forceps, and (2) in the *puerperium* when

septic symptoms have appeared which are probably attributable to the decomposition of pieces of placenta or membranes in the uterine cavity.

In cases of incomplete abortion before the end of the third month it is generally possible to remove the ovum completely by means of the finger. The vagina having been thoroughly douched and the operator's hands disinfected, the patient is placed in the dorsal position and anesthetized. The fundus is then depressed as far as possible, so that a finger may be passed up to explore the uterus thoroughly and remove any portions of the ovum which may still be adherent. Usually the greater part of the hand must be introduced into the vagina to enable the finger to reach the fundus. If the finger is found to be insufficient, the hand should be withdrawn, and the anterior lip seized with a volsella or a strong bullet-forceps to steady the uterus. Schultze's ovum forceps (Fig. 168) may be introduced first and an attempt made to remove the retained

FIG. 168.—Schultze's ovum forceps.

FIG. 169.—Blunt curette.

fragments. If this instrument fails also, a blunt curette (Fig. 169) should be passed into the uterus and gently manipulated until all adherent pieces are detached. It is important that the fundus be kept well depressed and the uterus steadied by the volsella while curetting is being done.

In the *puerperium*, if portions of placenta or membranes remain attached to the uterine wall, a douche will be insufficient to remove them, and they will not come away until uterine contraction has separated them entirely from their attachments. If septic symptoms have appeared, it would be dangerous to wait for their slow natural separation, and the blunt curette may be employed to remove them immediately. The instrument should be long and inflexible, the beak being bent at an angle with the shaft. The patient having been placed in the dorsal position, the anterior lip is seized with a volsella and drawn well down in order to straighten the uterus and open the cervical canal. The curette is then introduced and made to explore the whole uterine cavity carefully. The scraping should be done very lightly, no force being used, as

FIG. 170.—Doléris's écouvillon.

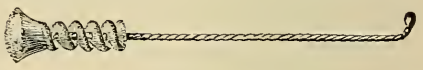


FIG. 171.—Modified écouvillon.

the uterine walls are thin and softened, and there is always danger of perforation unless the utmost gentleness is used. The greatest difficulty is experienced when the retained piece of placenta is situated at the fundus or in one of the cornua. After the uterus has been curetted, a hot intra-uterine douche should be given and an iodoform bougie passed up to the fundus. Some operators prefer packing a strip of iodoform gauze into the uterine cavity and allowing the end to protrude through the cervix, in order to promote contrac-

tion and secure free drainage. When no portion of the placenta has been retained, but the cause of septic infection is decidual débris or shreds of membrane, the brush (*écouvillon* of Doléris, Figs. 170, 171) is more effective than the curette and is much safer. Having been soaked in very hot water to soften the bristles, it is passed into the uterine cavity and gently rotated until it reaches the fundus. A few turns are usually sufficient to free the uterine walls from débris. The brush is then withdrawn, a hot intra-uterine douche administered, and an iodoform bougie or strip of gauze introduced as after curetting. The writer has modified the brush somewhat to enable it to reach the cornua in difficult cases. The operations of curetting and brushing are sometimes of great service, but are always attended with risk. They should be employed only in selected cases, and should be practised with the utmost gentleness. Neither curette nor brush should ever be used until the uterus has been steadied and its walls put on the stretch by means of the volsella. When the uterus is curetted or brushed, the operation should be done so thoroughly that it will not need to be repeated. If the septic symptoms continue, some practitioners are in the habit of curetting again and again, in the vain hope of thereby removing the focus of infection. Such practice cannot be too severely condemned, since it is rarely necessary to curette or brush more than once or twice. It has been urged as an objection to these operations that the brush and curette denude the uterine walls and open up fresh avenues for infection. Experience proves that such objections are groundless if the operator is careful of his technique.

The Tampon.—The tampon may be applied to the vulva, the vagina, the cervical canal, or the uterine cavity. The *vulvar tampon* is used in cases of labial thrombus where rupture has taken place and there is continuous oozing or free hemorrhage. The clots are turned out of the ruptured sac and the cavity is tightly packed with strips of iodoform gauze. Occasionally it may be necessary to pack the vagina also, in order to secure sufficient compression to make the tampon effective. The *vaginal tampon* is useful in cases of inevitable abortion in the early months of pregnancy, when the cervix is not sufficiently dilated to allow the finger to be passed into the uterine cavity in order to remove the ovum. When properly applied in such cases the vaginal tampon checks hemorrhage, stimulates the uterus to more active contraction, and allows time for the patient to rally from the effects of hemorrhage before other measures are employed. The tampon is sometimes used to induce labor by stimulating uterine action: the *intracervical* tampon is then employed, reinforced by the vaginal tampon. But in placenta prævia the tampon is of the greatest value; the cervical canal and the vagina are packed firmly enough to check hemorrhage and to prevent the escape of blood from the vulva. The tampon acts directly and indirectly: directly by dilating the cervix, distending the vaginal vault, and making direct compression; indirectly by exciting the uterus to vigorous contraction. The tampon is used also in hydatidiform moles as soon as the diagnosis is certain and hemorrhage has begun. It is occasionally of service in the treatment of post-partum hemorrhage, when the uterine muscle is weak and inert and cannot be stimulated to contract by other

means. In cases of rigid cervix or prolonged first stage in primiparæ it is sometimes employed as a dilator; it is claimed that by its use labor is shortened, the mother is spared much pain, and the child's life is placed in less jeopardy.

Materials for Tampon.—Various materials have been used for tampons, such as sponges, tents (sponge and tupelo), balls or pledgets of cotton wrung out of an antiseptic solution, strips of linen or cotton or sterilized gauze, either plain, borated, carbolated, sublimated, or iodoformed. Charpie is used extensively in France. A favorite tampon in Germany and in France is a rubber bag (colpeurynter) introduced flaccid and subsequently dilated with air or with water. When used as vaginal tampons these rubber dilators cannot be applied so firmly and do not make such even, steady pressure as the old-fashioned tampon. They are more useful as cervical dilators in cases of placenta prævia. Gauze, charpie, and absorbent cotton are safer than sponges.

Vaginal Tampon.—Absorbent cotton is soaked in carbolized water, the excess of fluid being squeezed out, and fifty or sixty balls or pledgets are prepared, each being about the size of a walnut. Some obstetricians use these pledgets separately; others attach them to a string or a strong thread at intervals of 6 or 8 inches, as in a kite-tail. Astringents are unnecessary, for they do not come in contact with the bleeding surface and they only serve to irritate the vaginal mucous membrane; a weak solution of carbolic acid is better. The pledgets having been prepared, the patient is placed in the Sims position, the perineum is retracted with a Sims speculum, and the cotton balls are carried up with long dressing-forceps and packed closely around the vaginal portion of the cervix, then over the os, then from above downward into the vagina until it is sufficiently well filled (Fig. 172). It is seldom necessary to pack the whole vagina, although in some cases this must be done. A T-bandage is then applied to keep the tampon *in situ*. When carefully packed about the cervix and filling out completely the dilatable upper portion of the vagina, the tampon is a perfect safeguard against hemorrhage. The tampon may be left undisturbed for twenty-four hours, and is then removed piece by piece from without inward, the vagina is thoroughly douched out, the bladder and rectum are emptied, and another tampon is introduced if necessary. A third tampon is seldom required. Too frequent tamponing irritates the vagina, causes more or less odor, and exposes the patient to the risk of septic infection. After twenty-four hours' tamponing many operators prefer to use carefully prepared sponge or tupelo tents, but, as a rule, tents are not to be recommended.

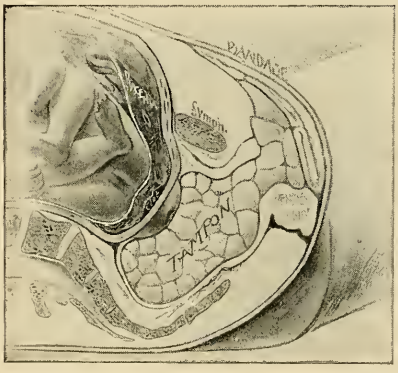


FIG. 172.—Tamponing the vagina with pledgets of cotton tightly packed around the cervix, more loosely in the lower portion of the vagina; guard and T-bandage are applied; case of placenta prævia with undilated cervix.

The Sims speculum is not always available, and it may be dispensed with. The patient is then placed in the dorsal position with legs and thighs flexed. The labia having been separated with two fingers, the pledgets of cotton are carried up to the vaginal vault and firmly packed about the cervix. The first balls may be smeared over with an ointment containing iodoform, boric acid, or carbolic acid. One layer after another is thus introduced until half the vagina is well filled. Many obstetricians prefer strips of absorbent cotton instead of balls or pledgets, because they are more easily removed; others use strips of sterilized gauze, either plain or medicated (Fig. 173). The strips should be 25 or

FIG. 173.—Tamponing the vagina with strips of gauze or cotton.

30 centimeters (10 or 12 inches) long and 5 or 7.5 centimeters (2 or 3 inches) wide; they should be smeared on one side with ointment, and be packed about the cervix in the same way as the pledgets. French obstetricians use ointments and cerates in large quantities when applying the vaginal tampon. Charpentier says that a pound or more of charpie may be required to seal the vagina hermetically; he prefers a borated cerate. Auvard, who uses cerates, says that sometimes as much as 500 grams (16 ounces) may be required; he lays great stress upon the abundant use of cerate. In applying the vaginal tampon some obstetricians begin by packing the cervix first, and then the anterior and posterior cul-de-sac, while others reverse this order. At all events, the occlusion of the uterus and the vagina must be hermetic, otherwise the tampon will be painful as well as ineffectual; it is therefore necessary in all cases to take great pains in packing the cul-de-sac gently and thoroughly, but not forcibly. Great differences of opinion seem to exist as to the length of time the tampon may be left *in situ*. From one hour to thirty-six hours are the limits that have been suggested.

Intra-uterine Tampon.—The intra-uterine tampon was introduced in 1887 by Dührssen. Plain antiseptic gauze is the best material; it attaches itself to the uterine walls, soaks up and drains away fluid, and swells when moistened without becoming hard or uncomfortable. It is used in strips 45 centimeters (18 inches) long and from 2.5 to 7.5 centimeters (1 to 3 inches) broad. When well applied it can be retained for forty-eight hours without danger or incon-

venience. In cases of post-partum hemorrhage the quantity which can be stuffed into the uterus is very great. Half a dozen sterilized gauze bandages 7.5 or 10 centimeters (3 or 4 inches) wide are not too much. The intra-uterine tampon is useful in hemorrhage at full term or after abortion, or where there is septic matter in the uterus after labor or abortion, whether curetting has been done or not; it is useful also when the uterus contracts imperfectly or irregularly after labor or abortion. In subinvolution it stimulates uterine contraction, relieves the turgid veins, and secures good drainage; in such cases it is generally preceded by irrigation and curetting.

Method of Application.—The bladder and the rectum having been emptied and the vulva and the vagina having been thoroughly cleansed, the anterior and posterior lips of the cervix are drawn down by means of two volsellæ. If the hemorrhage has occurred just after delivery and the hand can be passed into the uterus, the volsellæ are unnecessary. The uterine cavity having been cleared of clots and débris, a strip of gauze is carried up to the fundus and packed in until the free space about the fundus is completely filled. The firmness of packing is determined by the circumstances of the case; allowance should be made for the swelling of the gauze when soaked with secretions. When the uterine cavity has been sufficiently filled the volsellæ are removed, the vagina is lightly packed, and a firm abdominal bandage is applied. The tampon may be left in place for one, two, three, or even four days, according to circumstances, or it may be removed and renewed from day to day. Tamponing has been kept up in a myomatous uterus for a week. The state of the bladder and the rectum must carefully be watched while the tampon is in place. There are no contra-indications to the intra-uterine tampon if it is modified as to quantity, firmness, and length of application according to circumstances. It is easily removed by simple traction.

Episiotomy.—The term *episiotomy* is applied to the operation of incising the genitals during delivery to prevent their laceration, substituting a clean cut of definite size in a place where it can do no harm for a ragged tear of indefinite size in a place where it may cause immediate danger and subsequent injury. This name was given the operation by Michaelis (1799), who incised the median raphé of the perineum to prevent extensive laceration, but it is now applied to any incision of the external genitals for a similar purpose. Episiotomy has fallen into comparative disuse in England, America, and France, but is still common in Germany and Austria. The indications are—threatening central rupture of the perineum; great narrowness of the external genitals; excessive rigidity of the soft parts, especially from the presence of cicatricial tissue; faulty presentation; and undue size of the child's head. Opinions vary as to the site, number, and size of the incisions, but each case must be treated according to the indications present. French obstetricians prefer the oblique incision (recommended by Tarnier) which passes to one or the other side of the anus. Chantreuil recommends that where rupture into the rectum is threatened a median incision be made along the raphé and then be carried obliquely off on both sides of the rectum, the incision taking the shape of an inverted Y. German

obstetricians prefer incisions directed obliquely toward the posterior commissure. It is claimed that an incision of 1 centimeter ($\frac{3}{8}$ inch) increases the circumference of the vulvar orifice 2 centimeters ($\frac{3}{4}$ inch). The incision should be made during a pain with a pair of straight, blunt-pointed scissors. Winckel and Schultze advise waiting until the epidermis at the frenulum begins to tear. In America most authorities depend more upon care and skill in delivering the head than upon incisions for the prevention of perineal laceration. But when the rupture of the perineum threatens to involve the rectum, as in difficult forceps cases or where rapid delivery is necessary, an oblique incision passing well to one side of the anus will often save the rectum and leave a wound which can more easily and satisfactorily be repaired. Moreover, it is not so liable to be contaminated with the lochia, and primary union generally results. The technique of episiotomy has been described and illustrated on page 423, Vol. I.

Premature Induction of Labor.—The course of gestation may be arrested artificially at any period in the interests of either mother or child. If it is arrested before the child is viable, the operation is called the "induction of abortion;" if after the child is viable, it is called the "induction of premature labor." The date of fetal viability is therefore the dividing-line between these two operations.

Indications for the Induction of Abortion.—When the further continuance of gestation would seriously endanger the mother's life, it is justifiable to induce abortion in the interests of the mother. In uncontrollable vomiting with progressive emaciation, where all other treatment has failed, abortion is indicated. In grave heart, lung, and kidney troubles, pernicious anemia, severe chorea, advancing jaundice, etc., prompt arrest of gestation may be the only means of saving the mother's life. Whenever there is such mechanical obstruction in the genital tract that the birth of a viable child is impossible, abortion may be induced. Excessive contraction or deformity of the pelvis, tumors mechanically blocking the pelvis, extensive cicatricial contraction of the vagina or the cervix, and advanced carcinoma of the uterus or the vagina are the commonest forms of such mechanical obstruction.

Indications for the Induction of Premature Labor.—When the continuance of gestation to full term would expose mother or child to serious risks which might be diminished or avoided by the arrest of gestation, the induction of premature labor is indicated. No absolute rules can be formulated, but each case must be judged upon its own merits. The success which has attended modern Cesarean section and symphysiotomy has limited the range for this operation. If the mother's life is not imperilled, it is better to allow the child to attain its full development, and to deliver by section or by symphysiotomy than to bring into the world an immature child whose chances of living and thriving are frequently less. *Pelvic deformity* which would prevent the birth of a living child at full term, but which would allow the safe delivery of a premature viable child, used to be considered one of the main indications for the induction of premature labor. A conjugate of 6.75 to 7 centimeters ($2\frac{3}{4}$ inches) in the simple flat pelvis and of 7.5 to 8 centimeters (3 to $3\frac{3}{16}$ inches) in the generally-contracted pelvis

are the lowest limits usually set. But by symphysiotomy a full-term child can generally be delivered through a pelvis as small or even smaller with probably little more risk to the mother. In deciding upon the operative measures to be adopted in cases of moderate pelvic contraction it is only just to remember the claims of the induction of premature labor and the good results it has yielded in the past. In certain grave diseases which threaten the mother's life this operation will always hold its place. In *placenta prævia*, when a severe hemorrhage has taken place labor should be induced in the interests of both mother and child. In *eclampsia* many authorities believe that the safest treatment is the induction of labor; others, however, strongly advocate the expectant plan. In chorea, advanced heart and lung troubles, general edema, jaundice, etc., the operation is sometimes imperative. When there is a dead fetus *in utero* injuriously affecting the mother's health, or where the mother is likely to die before labor sets in, there can be no doubt as to the advisability of the operation.

Time to Operate.—The best time to select for operation is from two hundred and forty to two hundred and fifty days from the cessation of the last menstrual period. It is better to operate too early than too late. Schroeder generally operated in the thirty-sixth, rarely before the thirty-fourth, week.

Prognosis.—The prognosis for the mother is generally good, but should always be guarded. Besides the increased risk of septic infection, the state of the mother's health may materially affect the prognosis. If there has been serious organic disease, the chances of recovery will be lessened. For the child, the more immature it is, the worse is the prognosis; between the thirty-second and the thirty-sixth week its tenure of life is feeble and it will require the greatest care. The use of the incubator and artificial feeding greatly improve the chances of rearing very feeble infants (see p. 387).

Methods of Operation.—A great many methods have been employed for the induction of labor. Some are efficient, but more or less dangerous; others are safe, but less efficient. Some are prompt, and are most useful when speedy results are required; others are slow, and are applicable only when time is not of importance. It is obvious, therefore, that no one method is applicable to all cases.

1. *Puncturing the Membranes* (known as *Scheel's Method*).—A sound, quill, or other pointed instrument is passed through the os uteri and is made to rupture the presenting bag of membranes. The liquor amnii drains away and uterine action is set up. This method is safe if the rules of antisepsis are observed, and is most useful when it is desired to relieve uterine tension; but it is slow, and labor is apt to be tedious and painful on account of the early loss of the waters.

2. *Introduction of an Elastic Bougie into the Uterus* (known as *Krause's Method*).—After a vaginal douche has been given two fingers are passed up to the external os, and if possible through the cervix to the internal os; a well-oiled solid bougie (No. 10 or 12) is passed along the fingers and is guided by them into the uterine cavity between the membranes and the muscular wall

(Fig. 174). It is then gently rotated and made to work its way several inches upward toward the fundus. The higher it can be made to go, the more certain and rapid will be the onset of labor. A light vaginal tampon of iodoform gauze is then applied to keep the bougie from slipping out and to prevent the entrance of air or septic matters into the uterine cavity. If active labor-pains have not begun in twenty-four hours, the tampon and the bougie are removed, a thorough

Fig. 174.—Bougie passed through the cervix and between the membranes and the uterine wall, and retained by a light vaginal tampon.

vaginal douche is given, and another bougie is introduced on the opposite side of the uterus. Usually one introduction of a bougie suffices to induce labor, though sometimes two or three, or even more, may be required; exceptionally the method may fail altogether, and other measures will have to be employed. If the bougie can be passed its full length into the uterus, the onset of labor in a few hours will be almost certain. Krause's method is the safest and best for ordinary purposes when a speedy result is not required, and it is the one in most common use.

3. *Tamponing the Vagina.*—A vaginal tampon of gauze or of cotton pledgets, or a rubber bag (colpeurynter, Fig. 175) passed up to the cervix and dilated with air or water, is sometimes a useful auxiliary in the induction of labor, but is too slow, uncertain, and painful to be relied upon alone. It is of great service in placenta prævia and in some cases of accidental hemorrhage. It is useful also to strengthen labor-pains which are growing weak or to apply counter-pressure to a presenting bag of membranes which it is desirable to keep unruptured. The method of applying a tampon has already been described.

Fig. 175.—Colpeurynter.

4. *Dilatation of the Cervix.*—When it is required to empty the uterus as rapidly as possible, it may be necessary to dilate the cervix artificially. For a description of this method see page 407. There is more or less risk attending forcible dilatation, and it should not be attempted unless the case is urgent.

5. *Intra-uterine Injection* (known as *Cohen's Method*).—A special nozzle or an elastic catheter is passed between the membranes and the uterine wall, as in Krause's method; water or some other fluid is injected through the nozzle until tension is complained of. The injected fluid separates the membranes from their uterine attachments and stimulates contraction. The nearer to the fundus the fluid is conveyed, and the larger the area of detachment, the more certain and active will be the contraction. This method is efficient but dangerous; several fatal cases have been reported from shock and from entrance of air into the uterine veins.

6. *Vaginal Irrigation* (known as *Kiwisch's Method*).—A stream of hot water (100° to 120° F.) is directed against the cervix for ten or fifteen minutes at a time every two or three hours until labor-pains set in. Some obstetricians use cold water, while others follow the hot douche immediately with a cold douche for the purpose of obtaining a more stimulating effect. This method is tedious, painful, and uncertain, and it involves risk of congestion and metritis. A hot douche seems occasionally to augment the action of other measures, but the cold douche is apt to do harm, and is not to be recommended for general use.

7. *Electricity*.—The mild faradic current is said to be sometimes very effective. The negative pole is applied to the cervix in the posterior vaginal cul-de-sac, while the positive pole is placed over the sacrum or the lumbar vertebræ. This method has not come into general use, although it has recently attracted some attention; it is worthy of trial.

8. *Aspiration of the Uterus per Vaginam*.—When ordinary means fail and the case is very pressing, the uterus may be punctured and the liquor amnii aspirated. Two fingers are passed into the vagina and the most prominent portion of the corpus uteri is located. The aspirator-needle is then passed along the fingers and made to enter the uterine wall at right angles. After the liquor amnii has been aspirated the needle is withdrawn and uterine contraction closes the puncture.

9. *Injection of Glycerin* (known as *Pelzer's Method*.)—A special nozzle or a flexible catheter is passed through the os internum as in the Krause method, and half an ounce of pure aseptic glycerin is slowly injected between the membranes and the uterine wall. Some operators then apply a tampon to the cervix to prevent the escape of the glycerin. Pelzer first used 100 cubic centimeters (3½ ounces) of glycerin; he now prefers a smaller quantity (30 to 50 cubic centimeters) and repeats the injection if the first is unsuccessful. He explains the action of glycerin as an exciter of uterine contraction in three ways: (1) By mechanical separation of the membranes; (2) by a direct irritant effect on the uterine mucous membrane, as in like manner rectal glycerin injections set up muscular contractions which persist as tenesmus after the bowel has been emptied completely; and (3) by the affinity of glycerin for water, the liquor amnii being drawn through the membranes, causing more or less collapse. Pelzer does not use glycerin in eclampsia or in placenta prævia unless the attachment is lateral and the injection can be made without injuring the placenta. Some operators report

equally good results from tamponing the cervix with pledgets of absorbent cotton soaked in glycerin. Pfannenstiel holds that Pelzer's method is dangerous, because several cases have been reported in which glycerin produced nephritis. The method is still on trial; it has been warmly advocated by some obstetricians and severely criticised by others. The data are not yet sufficient to warrant a positive conclusion. Personally the writer has experienced most difficulty in securing the retention of the glycerin long enough to produce any decided effect.

As the operation of induction of abortion or of premature labor always involves more or less risk, it is advisable to obtain the advice and support of a colleague in consultation. Moreover, there often crop up certain moral and religious questions which the physician should not attempt to settle, but should leave to the decision of the family and its religious advisers. There have been employed for the induction of labor many other methods which do not merit serious consideration here.

Artificial Dilatation of the Os Uteri.—Labor may be delayed by the rigidity of the cervix or the external os, and it may be found necessary to dilate artificially in order to overcome the obstruction. Similar measures may be required when the condition of mother or child compels immediate delivery and the cervix is not sufficiently dilated to permit the use of forceps or other instruments. The dilators most commonly used for this purpose are either *hard* or *soft*. The hard dilators are made of metal or of vulcanite; the soft dilators are various patterns of rubber bags which are introduced into the cervix collapsed and are then distended with air or with water. In Germany Hegar's dilators are much used (Fig. 176). They are made of vulcanite, of polished steel, or of aluminum, and graduated from No. 1 to No. 44 or upward (Fig. 177). The smaller sizes can be passed through the cervix as easily as an ordinary uterine sound; the larger produce sufficient dilatation to permit the application of forceps or the introduction of one of the larger rubber bags.* The patient is placed across the bed in the dorsal position, with limbs everted and feet supported on a couple of chairs. The vagina is thoroughly douched out, the anterior and posterior lips of the cervix are steadied with volsella, and the fundus is pressed well down and supported

Fig. 176.—Hegar's dilators.

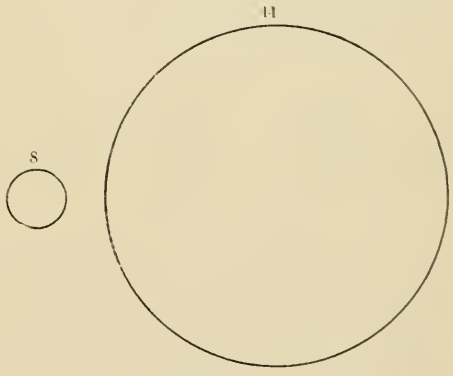


Fig. 177.—Actual calibre of Hegar's dilators, Nos. 8 and 44, showing the amount of dilatation produced.

* The circumference of No. 44 is 14 centimeters (about 5½ inches).

by an assistant. The dilators, having been made aseptic and well oiled, are passed in, one after another, beginning with the smaller numbers. It is often possible to dilate the cervix sufficiently in half an hour or an hour, especially

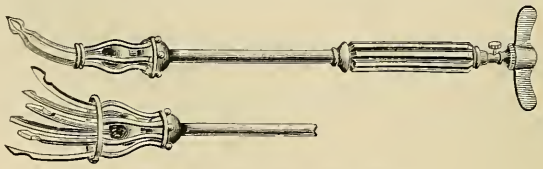


Fig. 178.—Six-branched dilator.

if the patient has been anesthetized. A speculum is seldom required. Müller, of Munich, quite recently introduced a steel dilator which works very well. It is on the principle of a glove-stretcher. In France a six-branched

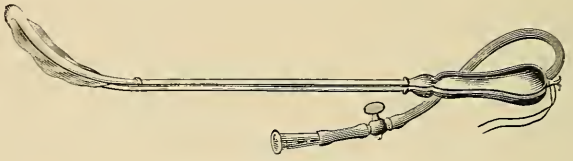


Fig. 179.—Tarnier's uterine dilator.

metal dilator (Fig. 178) or Tarnier's uterine dilator (Fig. 179) is preferred.* The latter instrument consists of two blades which are introduced like forceps-blades, locked, and then kept separated by means of a rubber ring slipped

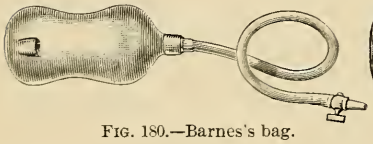


Fig. 180.—Barnes's bag.

Fig. 181.—McLean's model of Barnes's bag.

over the end of the handles. The elastic pressure of the rubber gradually overcomes the resistance of the cervix, while the presence of the instrument stimulates uterine contraction in a reflex manner.

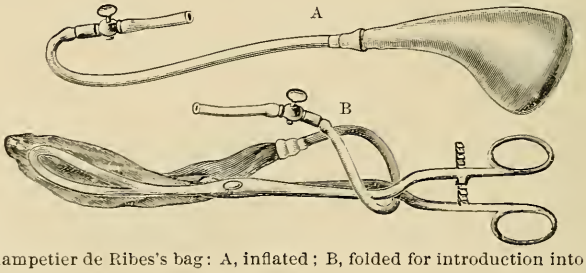


Fig. 182.—Champetier de Ribes's bag: A, inflated; B, folded for introduction into the uterus.

The soft-rubber dilators are of various kinds. Barnes's fiddle-shaped bags (Fig. 180), which are made in three sizes, are introduced by means of a sound.

* Bonnaire gives a full description of this instrument, its mode of application, its action, and its effects in the *Archives de Tocologie et de Gynécologie*, 1891, pp. 778, 881.

McLean's modification (Fig. 181) is folded up as small as possible and passed into the cervix in the grasp of a pair of uterine forceps. When once fairly in place the bag is gradually inflated with air or with water until the required dilatation is secured. Tarnier's dilator (Fig. 183), consisting of a rubber tube terminating at one end in a dilatable ball, is introduced by means of a special sound. When the bag is in place, the sound is withdrawn and water is pumped into the tube by means of a syringe fitting into the mouth-piece. The best of the soft dilators is that of Champetier de Ribes (Fig. 182). The bag is made of silk covered with rubber, and when distended it forms an inverted cone 8 centimeters ($3\frac{1}{4}$ inches) in diameter at its base. The silk prevents bursting of the bag—a serious objection to the other soft dilators. The bag, folded as small as possible, well oiled, and grasped between the blades of an applicator (Fig. 182, B), is slowly pushed through the cervix until half of it has passed within the internal os. The applicator is then relaxed, but is not removed until the bag has been pumped half full of warm water to ensure its retention. The applicator is then withdrawn, and the bag is slowly pumped full and left *in situ*. It acts as an artificial bag of membranes and produces safe and easy dilatation. Uterine action may further be stimulated by making traction upon the bag during a pain. The bag also prevents injurious pressure of the presenting part upon the maternal passages. Before the bag can be introduced the os must be dilated sufficiently to allow one finger to pass easily. It may be necessary to dilate to this extent with the finger or with Hegar's dilators. A similar dilatation may be required when Barnes's bags or other soft dilators are used. It is not essential for the membranes to be ruptured before the bag is introduced, though it is generally safer and better if they have been naturally or artificially ruptured. Champetier de Ribes's bag is a more powerful dilator than that of Barnes or Tarnier, and is also less liable to be displaced. Besides its use in placenta prævia and in the artificial induction of labor it has been found of great value in the treatment of accidental hemorrhage, prolapse of the funis, shoulder presentation with prolapse of an arm, and too early rupture of the membranes in slightly contracted pelves. The objections urged against it are that it may displace the presenting part or rupture the lower uterine segment if it is much thinned

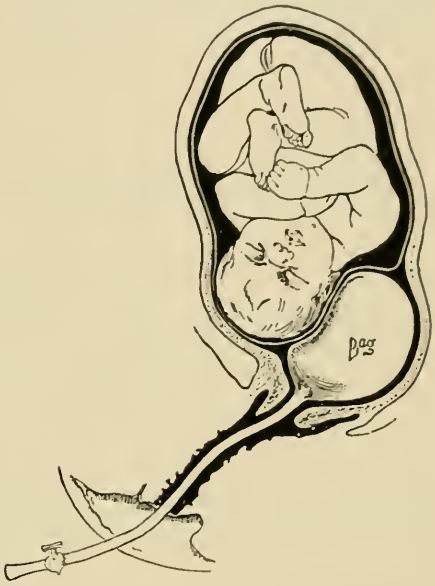


FIG. 183.—Tarnier's uterine dilator *in situ*: the bag is round in shape, but is compressed by the intra-uterine tension.

out; but if care is taken that the bag be not too suddenly or too forcibly distended, such accidents should not occur.

The Forceps.—So far back as the time of Hippocrates it was recommended in certain difficult cases of labor to seize the child's head with the hands and pull it down. This procedure was practically impossible until the invention of the forceps supplied the obstetrician with an instrument capable of being applied to the head while still in the parturient canal, and of exerting an amount of tractile force greater than that of the unaided hand. Although the use of forceps in obstetrics was mentioned by Avicenna (980–1030) and subsequently by other writers, it was not until the middle of the seventeenth century that the modern forceps was invented. The gradual development and perfecting of the instrument from the time of the Chamberlens to the present day make an interesting and instructive chapter in the history of medicine. Space does not permit a consideration of the historical side of the subject, nor a description of the numerous models which have been constructed, with their relative merits and demerits; it must suffice to point out the essential points of a good forceps and to indicate those models which are in most common use. No forceps is perfect or is equally adapted to all cases, and if a physician provides himself with only one pair, he should be careful to select a model which will be generally useful, even though it may be inferior for certain special cases. Moreover, he must use his forceps intelligently, knowing its limitations as well as its advantages, if he would minimize the risk of disappointment and failure.

The obstetric forceps consists essentially of two arms or branches, curved on the side so as to grasp the fetal head, articulated to maintain their hold, and provided with handles to facilitate traction. All forceps have this cephalic curve. The blades are usually fenestrated, to make them lighter and to give a better grip of the head with less compression. The wider the fenestration the firmer the grasp. In the Davis forceps (Fig. 184) great care has been taken to adapt the cephalic curve accurately to the contour of the head, and this curve has been adopted by Wallace (Fig. 191), Sawyer (Fig. 187), and others in the construction of the instruments which bear their name. Most modern forceps have a second curve (pelvic), to accommodate the instrument to the shape of the pelvigenital canal and to enable it to grasp the head firmly when situated at or just below the brim of the pelvis. Such instruments are sometimes called "double-curved" forceps. The pelvic curve is usually greater in French than in English and American instruments. Those possessing a marked pelvic curve are more suitable for high operations; those with moderate curve are more suitable for the low and medium operations, as they are less likely to interfere with natural rotation.

When the branches cross each other like scissors, they articulate at the junction of blade and handle; when they are parallel, as in the Asselini forceps, they articulate at the extremity of the handles. In some varieties the blade is joined to the handle by a shank, which gives solidity to the instrument and diminishes the elastic spring of the blades. The articulation is in the form either of the open English lock (Fig. 202) or of the more

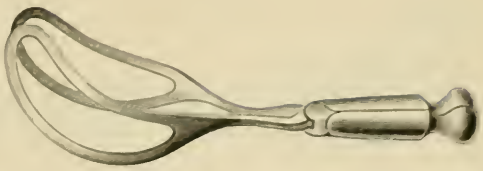


FIG. 184.—Forceps of Davis.

FIG. 185.—Forceps of Simpson.

FIG. 186.—Forceps of Barnes.

FIG. 187.—Forceps of Sawyer.

FIG. 188.—Forceps of White.

FIG. 189.—Forceps of Hodge.

FIG. 190.—Forceps of Dubois.

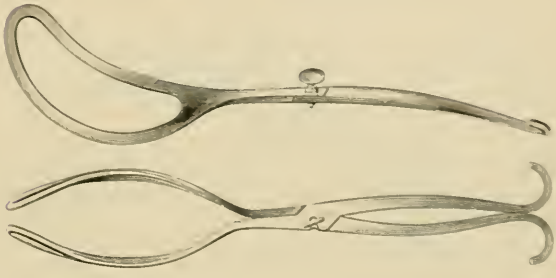


FIG. 191.—Forceps of Wallace.

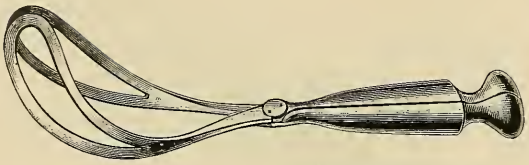


FIG. 192.—Forceps of Pajot.

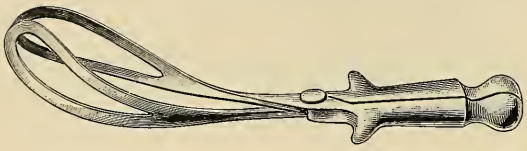


FIG. 193.—Forceps of Naegele.

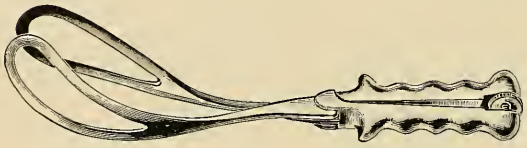


FIG. 194.—Forceps of Elliott.

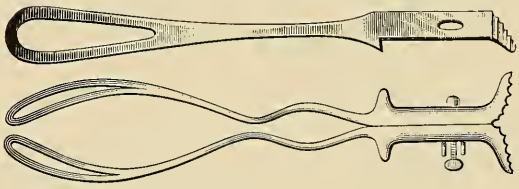


FIG. 195.—Forceps of Lazariewich (straight).

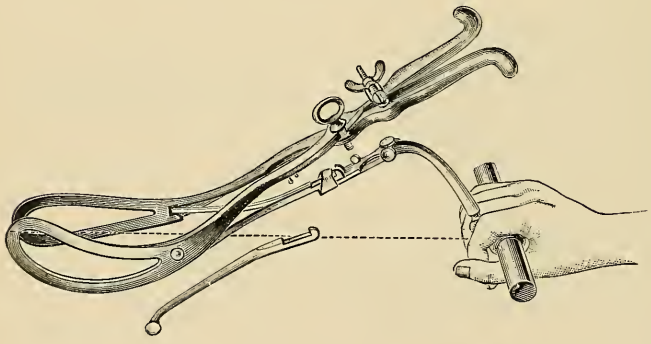


FIG. 196.—Axis-traction forceps of Tarnier (to show the details the hand is represented in an improper position for traction; below is one of the traction-rods).

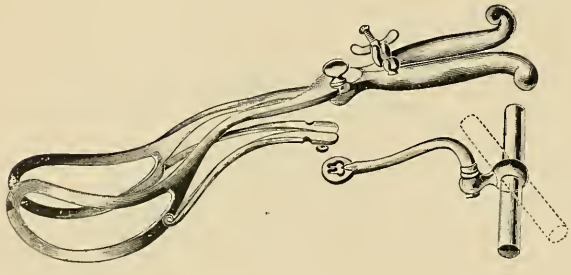


FIG. 197.—Lusk's modification of the Tarnier forceps (the traction-rods are shown free from the catches that hold them during application of the blades and ready for attachment of the tractor).

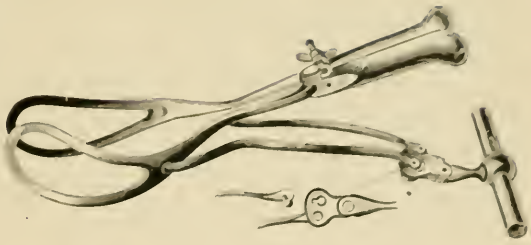


FIG. 198.—Axis-traction forceps of Simpson.

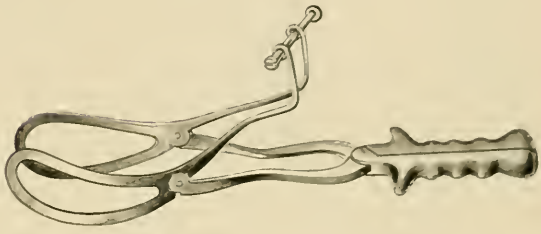


FIG. 199.—Axis-traction forceps of Breus (the rods having the right-angled bend are against the shank when application is made).

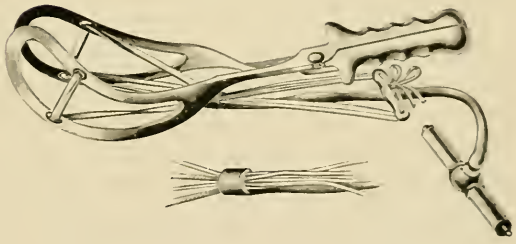


FIG. 200.—Axis-traction forceps of Poulet (tapes run through eyes in blades and through ring on traction shank, and fastened to a cross-bar).

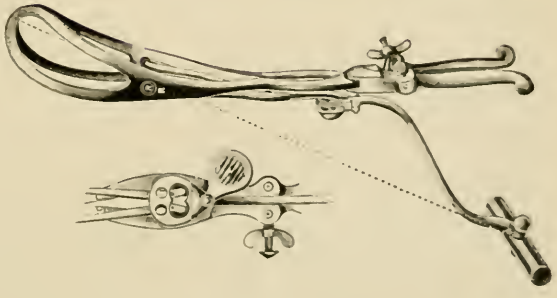


FIG. 201.—Axis-traction forceps modified by Jewett (after Milne-Murray's specifications, with details of lock).

complicated French mortise and tenon, tightened by means of a screw to prevent the blades from disarticulating (Fig. 202). In some forceps there is a fixed tenon on one branch and a mortise on the other, but no screw to fix the joint. For general use the English lock is preferable. The handles may be quite plain, or be serrated, grooved, or roughened, to give a better hold. Some have a ring in the shank (Barnes's, Fig. 186), or projecting shoulders (Simpson's, Fig. 185) to facilitate traction. Forceps, whether single-curved or double-curved, are either *long* or *short*. The short forceps is usually from 22.5 to 25 centimeters (9 to 10 inches) in length, the long forceps from 32.5 to 40 centimeters (13 to 16 inches); Tarnier's axis-traction forceps is about 45 centimeters (18 inches) long. The short forceps is now very little used; it is a relatively feeble instrument, adapted only for the low operation, and has no special advantages over the longer instrument, which is equally fitted for high, low, and medium operations. Sawyer's is the best model of the short forceps; it is light, its blades are thinner and less bulky than those of the ordinary long forceps, and some obstetricians use it to help the head over the perineum.

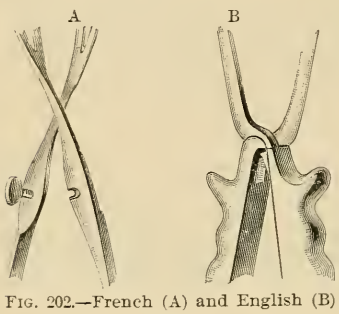


FIG. 202.—French (A) and English (B) locks.

In recent years much attention has been paid to *axis-traction*—that is, traction in the axis of the parturient canal. Whenever traction is not in the right direction, a certain amount of the tractile force is wasted against the pelvic walls, and the maternal soft parts are apt to be injured. The fetal head, too, is subjected to more compression, since a greater amount of tractile force is required to effect delivery. The best axis-traction forceps is that of Tarnier (Fig. 196), either the French model or Lusk's modification (Fig. 197). Jewett's forceps (Fig. 201) is also a very serviceable instrument, being lighter and less bulky than the Tarnier model. The Breus forceps, so much used in Germany, is lighter and less clumsy, but not so powerful as that of Tarnier. Simpson added axis-traction rods to the ordinary Simpson forceps (Fig. 198), and tractors have been contrived for most of the well-known long double-curved instruments. Stevenson fits a blunt-hook tractor to the lock of the ordinary forceps and thus makes axis-traction. Poulet accomplishes the same result by means of cords passed through holes drilled in the cephalic portions of the blades (Fig. 200). The axis-traction forceps is useful in the high or medium operation, but is unnecessary and cumbrous in the low operation; the higher the head, the more useful will this kind of forceps be found.

A good forceps should be made of well-tempered steel; the blades should be well polished and nickel-plated, and heavy enough to be firm without too much spring. The cephalic portion should be comparatively light and the shanks strong, the edges of the blades and the fenestræ being rounded and smooth. The fenestræ should be of moderate width (from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches); the tips of the blades should be from 1.3 to 2.5 centimeters ($\frac{1}{2}$ to 1 inch) apart when

closed, the greatest distance between the blades in the cephalic portion being from 6.3 to 7.5 centimeters (2½ to 3 inches). The blades should lock easily; the handles should be of metal, smooth, and provided with a convenient shoulder for traction. Wooden handles, complicated locks, and compression-screws should be avoided, and the instrument should be so constructed that it can easily and thoroughly be rendered aseptic. In England the favorite forceps is that of Simpson or of Barnes, or the Simpson-Barnes, which has the Barnes blade and the Simpson handle. In America the Simpson (Fig. 185), Barnes (Fig. 186), Hodge (Fig. 189), Wallace (Fig. 191), White (Fig. 188), and Sawyer forceps are extensively used. In France some modification of the original Levret is used, such as the Dubois (Fig. 190), Pajot (Fig. 192), or Stoltz forceps; for axis-traction the Tarnier forceps (Fig. 196) is the favorite, though many prefer the simpler Poulet (Fig. 200). In Germany the Naegele (Fig. 193) or Braun's modification of the Simpson forceps seems to be in commonest use; for axis-traction the Breus (Fig. 199) and the Simpson (Fig. 198) models are preferred to that of Tarnier. Generally speaking, those obstetricians who follow the English method, and apply the forceps to the sides of the pelvis regardless of the position of the fetal head, use the Simpson or the Barnes forceps or some modification of them; while those who follow Baudelocque and use the Continental method, applying the forceps to the sides of the child's head regardless of its position in the pelvis, prefer the Continental model of forceps, which is usually a modification of that of Levret.

Action of the Forceps.—The obstetric forceps may act in four different ways: (1) As a *tractor*, (2) as a *compressor*, (3) as a *lever*, and (4) as a *rotator*.

1. *Tractor.*—Traction supplements a deficient *vis-a-tergo* by sufficient *vis-a-fronte* to effect delivery, or replaces it altogether if the driving power of the uterus has become exhausted. The amount of force applied is under the control of the operator; it may be much or little, continuous or intermittent, according to the necessities of the case. During traction there is always a certain amount of compression and leverage, and usually more or less rotation. The forceps, therefore, cannot be used as a tractor only, but becomes a lever, a compressor, or a rotator of greater or lesser power according to the amount and direction of tractile force employed. To be a good tractor the forceps must have a good grasp of the head, and the blades must not slip or spring apart when traction is made. To effect delivery with a minimum of force, traction must be made in the axis of the parturient canal. The tractile force employed never should exceed 70 to 80 pounds.

2. *Compressor.*—In normal labor as the head descends it becomes elongated and moulded by the resistance of the pelvis and the soft parts. During forceps delivery a similar compression and moulding take place. While the head is being pulled through the resistant canal it dilates the passages as it advances and at the same time is compressed by them. When traction is applied compression begins; when traction is stopped compression ceases. The amount of compression is directly proportional to the amount of tractile force employed. As undue compression imperils the child's life, it is obvious that too

much tractile force is dangerous for the child and should therefore be avoided. Long-continued compression is more likely to be injurious than intermittent compression, and a child may safely bear a greater amount of compression applied intermittently than if it is applied continuously. It is evident, therefore, that in the interests of the child traction should be gentle and intermittent, not forcible and continuous. Compression also may be made by the direct action of the blades. When the handles are long, as in the French forceps, the head can be compressed powerfully by forcibly pressing the handles together, since the leverage is good; but when the handles are short, as in the English instruments, there is little leverage, and consequently only feeble compression. Some forceps are fitted with a screw by which the blades can be brought together so forcibly as to exert powerful compression upon the head. Such contrivances are dangerous, and should be used only in exceptional cases. The forceps is chiefly and primarily a tractor, not a cephalotribe. It is usually stated that the head may be compressed from 0.6 to 1.3 centimeters ($\frac{1}{4}$ to $\frac{1}{2}$ inch) without danger; however, this cannot be taken as an invariable rule, since a great deal depends upon the degree of ossification and mouldability of the head, as well as upon the rapidity and continuousness of the compression. Facial paralysis in the child sometimes results from compression during delivery, either (1) from direct compression of the facial nerve as it emerges from the stylomastoid foramen, below and in front of the ear, or (2) from peripheral compression of the brain by the blades pressing too forcibly upon the parietal bones. This accident would occur less frequently if the operator would tighten the compression screw of his axis-traction forceps, or compress the handles of his ordinary forceps sufficiently to secure a firm and steady grip of the head before he begins to make traction. If this little precaution be not taken, the blades will be apt to slide forward when traction is begun, compressing the nerve between the end of the blade and the skull.

3. *Lever.*—The usefulness or the harmfulness of the lever action depends upon what constitutes the fulcrum. If the instrument be swayed violently from side to side, pivoting first upon one side of the pelvis and then upon the other, delivery may be effected rapidly, but the maternal soft parts will surely be bruised between the forceps-blades and the pelvis; but if the forceps be used as a double lever, as recommended by Barnes, each branch being made to act alternately as a fulcrum for the other, a gentle oscillating movement of the head will be produced, and less tractile force will be required than if a straight pull be employed. A box or a barrel may more easily and safely be moved along a narrow passage by tilting or canting it from side to side: so, too, the fetal head may be drawn through the narrow curved parturient canal more easily and safely by a gentle to-and-fro lever movement than by a straight, steady pull. It is important to remember that this pendulum movement must not be used *alone*, but always while traction is being made; it is meant to supplement traction, not to replace it. Some operators use the forceps as a lever of the first or third order. Pajot frequently adopted this plan; Dr. A. H. Smith of Philadelphia for many years taught and practised a similar method, using

one hand as a fulcrum at the lock. Considerable strength and dexterity are required to use the forceps in this way, and there is always danger of the blades pivoting upon the under surface of the symphysis or the arch and injuring the soft parts.

4. *Rotator.*—If there be used a good model which has not too great a pelvic curve, and if traction be made properly, the head should rotate in the normal way as it descends. If the handles be held too firmly, the head is apt to be dragged straight through without rotation; but if traction be made upon the shoulder or the ring of the instrument at the level of the lock, the handles being left comparatively free and not tightly grasped by the hand, the forceps will seldom interfere with the natural mechanism of rotation. In the one case the forceps determines the way in which the head shall descend; in the other case the head descends according to the natural mechanism and carries the forceps along with it. Some operators use the forceps to rotate the head artificially for the purpose of correcting faulty positions. Such a practice is dangerous, and should not be attempted by any one who is not sure of his diagnosis, possessed of wide experience, and expert in obstetric manipulation. It is generally safer to allow the head to rotate naturally as it descends; but if artificial rotation is to be done, the straight forceps should be used in preference to the double-curved instrument (see p. 506, Vol. I.).

Indications.—The forceps may be applied to the presenting head, the after-coming head, or the breech. If the head is presenting, it should be engaged in the pelvis, it should be of normal firmness and proportionate in size to the parturient canal, and there must be no mechanical obstacle to delivery necessitating the use of great force to overcome it. The membranes should be ruptured and the os should be dilated or dilatable. The operation is indicated—(1) In lingering labor when the natural efforts are unable to effect delivery; (2) when speedy delivery is imperative in the interest of the mother, as in hemorrhage, convulsions, exhaustion, advanced cardiac or pulmonary disease, etc.; (3) when speedy delivery is indicated in the interest of the child, as in impending death of the mother or threatening asphyxia of the child.

The Operation.—Ever since the days of Smellie and Levret there has been a keen controversy respecting the best method of applying the forceps. Smellie formulated the rule that the blades should always be applied to the sides of the child's head, so that it may be grasped in the biparietal diameter. Levret adopted Smellie's rule. Saxtorph of Denmark (1740–1800), a pupil of Smellie, criticised this method, and advocated the application of the blades to the sides of the pelvis, regardless of the position of the child's head. He argued that the pelvic curve was added in order to accommodate the forceps to the natural curve of the pelvis, and that its maximum advantage is obtainable only when the two curves exactly coincide. Any divergence between them is accompanied by loss of advantage from the pelvic curve. His teaching had many followers until Baudelocque's powerful advocacy of the old Smellie method re-established it as the rule of practice on the Continent. In England, Ramsbotham, Simpson, and Barnes have done much to abolish the use of short forceps: as these

instruments have disappeared Smellie's method has gone too, and Saxtorph's rule is now generally adopted. It is very curious that, although the application of the blades to the sides of the head originated in England, it has been replaced in that country by the old Continental method of application to the sides of the pelvis; while on the Continent the old Saxtorph method has been abandoned for the original Smellie method of application to the sides of the head. At the present day, therefore, we find two distinct methods in use, one adopted by the English, the other by the Continental school. The English apply the blades to the sides of the pelvis, regardless of the head; Continental obstetricians apply them to the sides of the head, regardless of the pelvis. The English method is simpler, easier, and less likely to injure the maternal passages; the Continental method is more complicated and difficult, but less likely to injure the child's head. On the whole, it is safer and better for beginners to learn and practise the English method; when they become more experienced and expert they may sometimes find the Continental method preferable.

The forceps operation is divided into the *high*, the *medium*, and the *low* operation. It is called *high* when the head is at or in the brim, but has not yet descended into the excavation; *medium*, when the head has passed the brim and entered the excavation, but has not yet come down upon the pelvic floor; *low*, when the head is pressing upon the floor and presenting at the outlet. When we say that the head is at or in, but not through, the brim, we mean that its widest plane (the biparietal) is at or in the plane of, but has not passed through, the brim. The higher the head the more difficult and dangerous the operation. The low operation is generally easy and safe for both mother and child; the medium is harder, but not usually dangerous to either; the high operation is difficult and dangerous, and should be attempted only in exceptional cases. The tendency of modern practice is to limit very much the field of the high operation. Pinard insists very strongly that forceps should not be used to overcome osseous resistance, whether at the brim or at the outlet. Version and symphysiotomy are then safer alternatives. The method of applying forceps in the low and medium operations is practically the same, and will be described first.

Position.—In England it is customary to confine in the left lateral position; on the Continent and in America the dorsal position is generally preferred. In the latter position the blades are more easily applied; in the former extraction is easier and safer. A very good plan is to combine the advantages of both positions by applying the blades in the dorsal position and then turning the patient into the left lateral position for delivery.

General Preparations.—Before beginning the operation the bladder and the rectum should always be emptied, the vagina should be douched thoroughly with a hot antiseptic solution, and the vulva should carefully be washed and scrubbed. The operator's hands, the instruments, and everything which may come in contact with the parturient canal should, of course, be made aseptic. Lubricants are unnecessary if the hands and the instruments are dipped in a creolin solution; soap is preferable to oil or vaselin if creolin is not at hand.

It is well to provide plenty of boiled water, both hot and cold, and to place within easy reach a basin of warm water for rinsing the hands, and another of creolin for use during the operation, as well as jute or absorbent cotton to cleanse the vulva, perineum, and anus. The bed should be protected with a clean mackintosh sheet, and a suitable receptacle should be arranged to catch the discharges. Anesthesia should be used unless specially contra-indicated, for it not only saves the patient much pain, but also makes the operation easier and diminishes the risk of injury to the parturient canal; if possible, the management of the anesthetic should be entrusted to a competent assistant.

Operation in the Dorsal Position.—The patient is placed across the bed, with the head supported on a pillow, the hips well over the edge of the bed, the thighs everted, and the feet resting on a couple of chairs. Some operators prefer placing the patient in the lithotomy position, the knees being supported and steadied by a couple of assistants. The operator sits in front of the patient,

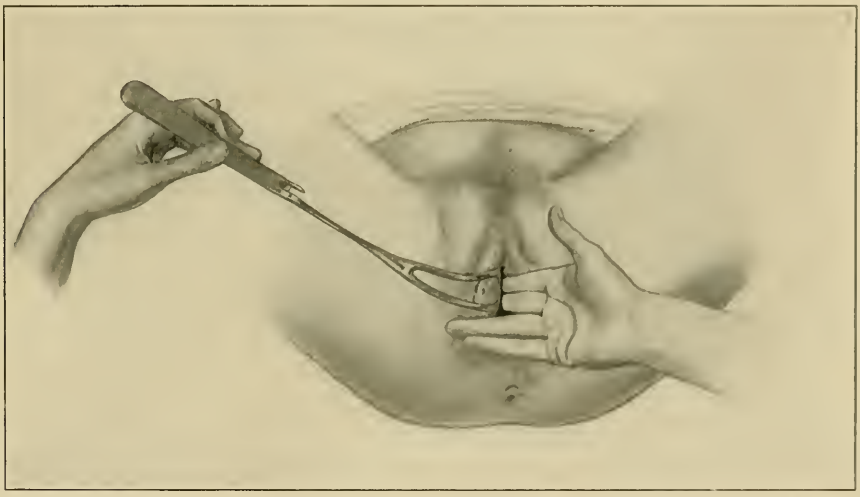


FIG. 203.—Method of lightly grasping and placing the lower blade for application; the arrow shows the arc followed by the handle as the blade passes upward.

between the everted thighs. The lower blade of the forceps is passed first into the left side of the pelvis, then the upper blade is passed into the right side; when properly adjusted, the blades are locked and extraction is begun. To introduce a forceps-blade properly both hands are used, one to pass the blade, the other to guide it up to and around the head. The *lower* blade is passed by the *left* hand into the *left* side of the pelvis, while the fingers of the right hand guide it internally; the *upper* blade is passed by the *right* hand into the *right* side of the pelvis, while the fingers of the left hand guide it internally. To make sure of the proper blade, it is always well, before introducing the blades, to lock them and hold them with the pelvic curve looking upward, and then select the lower blade. The lower blade, beak upward, is held lightly in the left hand, with the knuckles up, the thumb upon the flat of the handle, and four fingers upon the outer portion, as shown in Figure 203. No force is

needed to pass the blade; it is slipped along the fingers of the internal hand and is guided by them around the convexity of the head; the handle is then swept downward along the internal surface of the mother's left thigh, and the blade passes easily into position between the head and the left lateral wall of the pelvis. Then the upper blade, held in the right hand in similar fashion, is passed along the fingers of the left hand, well up around the head-globe, and the handle is swept downward along the mother's right thigh into its proper position in the right side of the pelvis (Fig. 204). If the pelvic curve of the instrument corresponds with that of the pelvis, the handles should be horizontal, looking one to the right thigh and the other to the left. The handles are then depressed, and by gentle manipulations are maneuvred into locking without

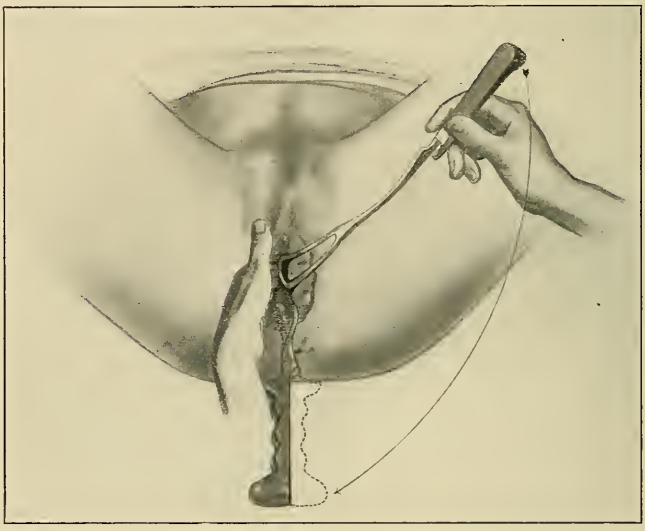


FIG. 204.—Beginning application of the second or upper blade. The handle follows the direction of the arrow to reach the position shown faintly near the first blade in place.

the exercise of any force. Care should be taken not to include hair or the labia in the bite of the lock. When the blades lock easily, it is usually considered that the case is suitable for the forceps operation. The proper management of the internal hand greatly facilitates the introduction of the blades; in fact, much of the difficulty experienced by beginners in introducing the blades is caused by failure to use the internal hand properly. To guide the lower blade into position, two fingers of the right hand should be passed along the left lateral wall of the vagina into the cervix and be pushed up as high as possible upon the left side of the presenting head-globe; then, with the finger-tips pivoting upon the head, the back of the fingers and the hand should be made to press the cervix, vagina, and vulva as far as possible toward the left. Then the forceps blade can be slipped easily along the palmar aspect of the fingers well up over the convexity, whence it glides around the head without difficulty and with little or no expenditure of force. The commonest error is the failure to pass the fingers of the internal hand far enough and to press the

cervix and vagina sufficiently to the left. In passing the upper blade (Fig. 204) the fingers of the left hand are passed into the cervix in a similar man-

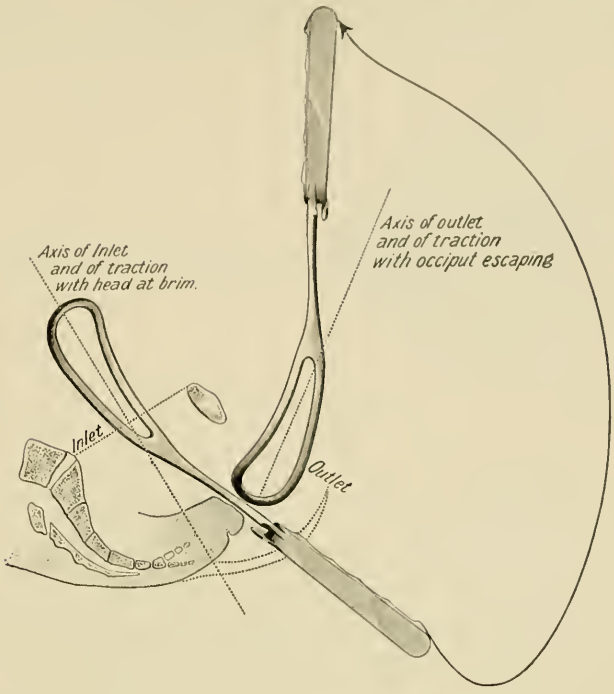


FIG. 205.—Axis of traction in the high operation corresponding with the axis of the inlet. Direction of the traction, as the forehead escapes, is nearly at right angles to the long axis of the mother's body. The arrow follows the course taken by the end of the handle.

ner, and the lateral walls are pressed as far as possible toward the right. In the low operation, if the head has emerged from the uterus and the cervix has

FIG. 206.—Low forceps application; side view of the application of the second blade: I., blade started; II., blade in position and forceps locked.

retracted, the introduction of the blades is much easier, as it is then no longer necessary to consider the cervix (Fig. 206).

After the blades have been locked slight traction should be made, to determine whether the head is firmly seized by the forceps, and whether any portion

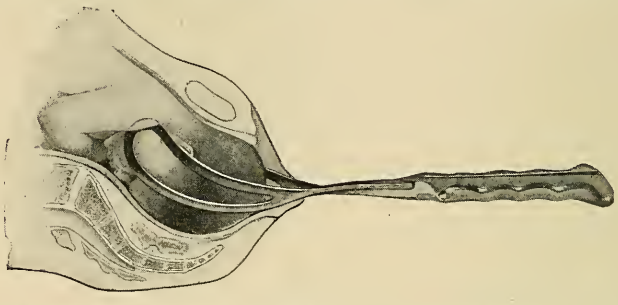


FIG. 207.—Horizontal traction on a head which is beginning to distend the pelvic floor, the occiput being under the pubic arch.

of the cervix or membranes has been included in its grasp. Extraction is then effected by pulling steadily or with a slight pendulum movement in the axis of the pelvic canal. Some authorities utterly condemn the pendulum movement, and insist that the straight pull is always safer (Fig. 207). In the high operation the handles must be pressed back against the perineum as far as possible (Fig. 205), to make the line of traction correspond with the axis of the brim; as the head descends the traction becomes horizontal (Fig. 207), and is finally directed upward (Fig. 208) as the head distends the perineum and emerges from the vulva. In the medium and low operations the line of traction is not so far backward. If the pains are strong, traction should be made during a pain and intermitted during the interval; but if the pains are feeble or absent, traction should be made for a minute or two and then be stopped, so as to avoid the dangers of too forcible compression of the fetal head and too rapid dilatation of the parturient canal. Too speedy delivery endangers the child's life and exposes the mother to the risks of laceration and hemorrhage. In primiparæ half an hour should be allowed for the delivery of the head over the perineum. In the high and medium operations it is a good plan to keep the left index finger upon the presenting part during traction (Fig. 209), to determine

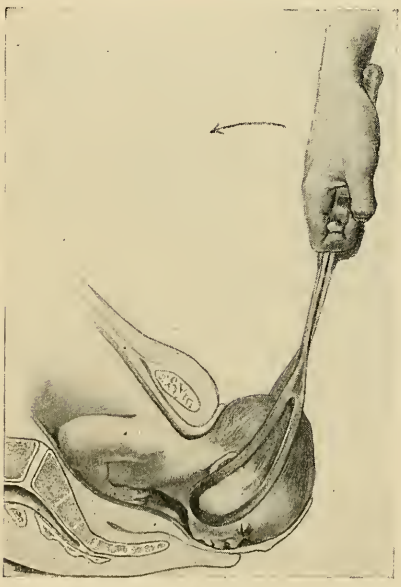


FIG. 208.—Upward traction when the occiput has passed the pubic arch and the pelvic floor is on the stretch.

whether traction is being made in the right direction and whether the head is descending and rotating properly or is being too forcibly compressed. If the head rotates as it descends, the forceps will rotate along with it, and the handles will turn from the horizontal position into the oblique or the antero-posterior; the blades should be unlocked and readjusted before the antero-posterior diameter is reached, or injurious pressure may be made upon the vestibule and urethra in front or the perineum and rectum behind. Sometimes the blades require to be readjusted several times before delivery is completed.

Should the blades be removed before the head is completely delivered? Opinions are divided on this point. Those who favor non-removal claim that the forceps gives the operator greater control over the head as it comes through the vulva, and enables him to flex or extend it at pleasure, or hold it back if a violent pain drives it down too suddenly upon an insufficiently dilated perineum.

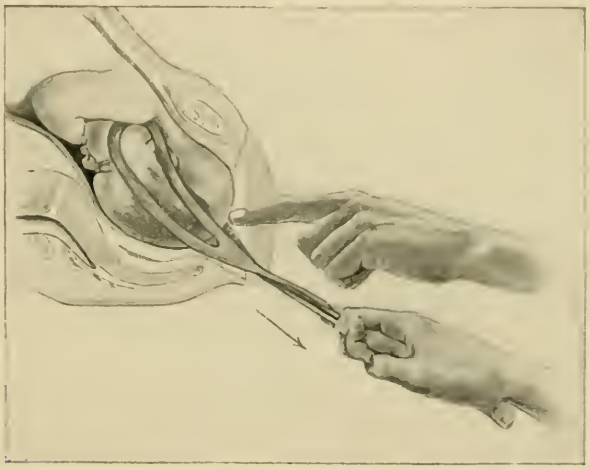


FIG. 209.—Finger determining direction of traction and amount of rotation and descent.

Those who favor the removal of the blades maintain that thereby a certain amount of room is gained, and the vulva does not need to be so much distended to permit the passage of the head; moreover, the head can more safely be piloted beneath the pubic arch by the hand than by the forceps. Upon the whole, better results are obtainable if the blades be removed when the head has descended sufficiently to bring the chin to the tip of the coccyx. They should be removed slowly during an interval between the pains, and in the reverse direction from that in which they were introduced.

In forceps operations, when the head descends in the transverse diameter and does not rotate forward, the blades should be removed as soon as the head reaches the muscular pelvic floor. Non-rotation is apt to occur in flat or funnel-shaped pelves, or when the fetal head is large and the occiput wide. In such cases the head may become impacted in the pelvic outlet, whence it cannot be dislodged by the natural efforts, and the child may perish,

or the maternal passages may slough from pressure if the application of forceps be too long delayed. Before resorting to forceps, however, the patient should be anesthetized and an attempt made to rotate the head by means of two fingers passed up behind the ear which lies close to the symphysis, as recommended by Tarnier. This maneuvre will probably fail in cases of contracted pelvis. Care having been taken to promote flexion, the forceps-blades should be applied to the sides of the pelvis and traction made until the head reaches the muscular floor, when they should be removed. The head can then be rotated by means of two fingers placed on the posterior fontanelle, the forehead being pressed backward by two fingers of the other hand. If the head be dragged through the outlet in the transverse diameter, extensive laceration will certainly take place. Some operators prefer the oblique application of the forceps; others attempt to rotate the head by means of the forceps. The latter practice is dangerous and should be avoided if possible.

Application of the Forceps to the Sides of the Child's Head.—Continental text-books give detailed descriptions of the application of the blades in the various positions of the head, but such descriptions are generally confusing to beginners. It is much simpler and easier to introduce the blades in the manner already described, and then, before locking them, to manœuvre each blade over the side of the head which it is to grasp. When the blades are fairly applied over the sides of the head, they can be locked and extraction effected in the usual manner.

The High Operation.—Opinions are divided as to the indications for the high operation. Some operators claim that in certain emergencies the forceps may be used even if the head is not yet engaged in the brim; others hold the operation to be unjustifiable until the head is well engaged; while others, again, insist that the largest diameter of the head shall have passed the brim before forceps can safely be applied. There can be very little question of the great danger to both mother and child if the head is not well engaged in the brim; under such circumstances version is safer and better. But when the head is well engaged and there is no disproportion between it and the pelvis, and the os is fairly dilated or dilatable, there need be no serious risk to the mother or the child. The chief danger to the child is from compression during the prolonged and sometimes forcible traction which may be required to overcome the resistance of the maternal soft parts. The danger to the mother is from laceration and bruising of the lower uterine segment, the cervix, and the vagina during extraction. However opinions may differ as to the proper way of applying the blades in the medium and low operations, there can be no doubt that in high operations it is best to apply them to the sides of the pelvis without regard to the position of the child's head. As the head usually engages in the brim either in the transverse or the oblique diameter, it will be grasped by the forceps antero-posteriorly or obliquely. If antero-posteriorly, one blade will be over the forehead and the other over the occiput; if obliquely, one will be over a parietal protuberance and the other over the opposite coronal suture. During traction the forceps is apt to slip and to wound the soft parts unless

the handles are well compressed; or the flexion of the head may be impaired and extraction be made more difficult. It is of the utmost importance that traction should be made in the axis of the pelvis to minimize the amount of traction force employed. The axis-traction forceps has been devised for this purpose. With the ordinary forceps more or less force is wasted against the symphysis, with the result that the maternal tissues are bruised and the fetal head is needlessly compressed. A glance at Figure 210 will show the advantage of axis-traction at the brim and the impossibility of securing it with the ordinary forceps. Another great cause of difficulty and danger in the high operation is

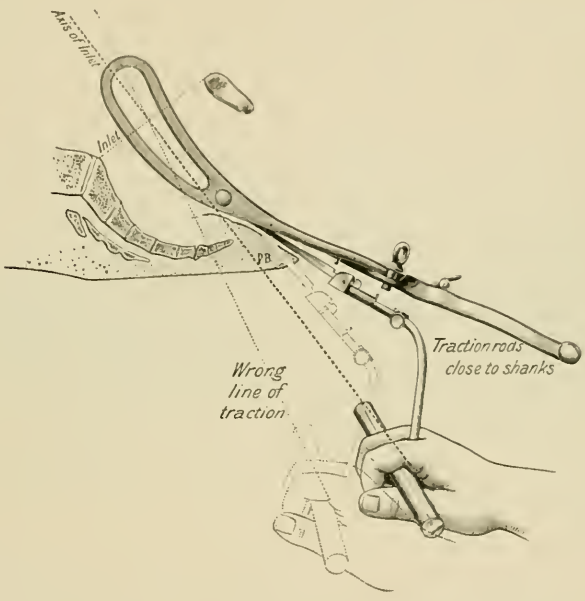


FIG. 210.—Diagram showing the right and wrong methods of pulling on the handle-bar, and that the line of traction is directly in the axis of the inlet (much modified from Ribemont).

the imperfect dilatation of the os and the resistance offered by the cervix. If the operator attempts to overcome this by sheer force, he will most probably need to use an amount of traction that will prove dangerous to mother and child. It is better to overcome cervical resistance by artificial dilatation before the forceps is applied than by main force afterward. If there is no time for artificial dilatation, the cervix should be incised; *accouchement forcé* is now rarely justifiable. By the use of axis-traction forceps and artificial dilatation of the cervix the high-forceps operation may be shorn of its chief dangers. Extraction should not be hurried, but plenty of time should be allowed for the moulding of the head and the dilatation of the soft parts. The axis-traction forceps offers no advantages at the pelvic outlet, while it takes up more room: many operators remove it when the head comes down upon the perineum, and complete the delivery with a lighter and less bulky instrument. It is

only fair to mention, however, that Milne-Murray advocates the use of axis-traction forceps in all cases of instrumental delivery, maintaining that this instrument is better than the ordinary model even in low operations.

In Occipito-posterior Positions.—When the occiput is directed posteriorly, the case should be left to nature as long as possible, in the hope that forward rotation may take place. Some authorities recommend in such cases the use of forceps to turn the occiput forcibly to the front. Such a maneuvre rarely succeeds; it is capable, moreover, of seriously injuring the child by rotating the head upon the trunk more than it is safe to do. But if the natural efforts fail, or there is need for speedy delivery, the forceps may be applied and simple traction be made. Natural rotation may still take place, but if it does not the head may safely be delivered in the occipito-posterior position. The blades

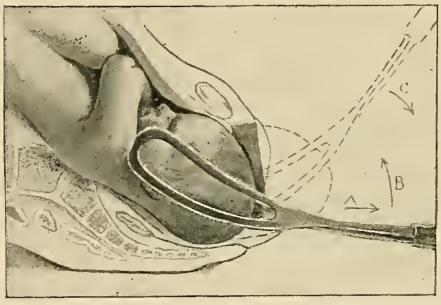


FIG. 211.—Forceps extraction in persistent occipito-posterior position: A, initial line of traction; B, direction in which forceps-handles are lifted; C, direction of forceps, after occiput has escaped, in order to deliver the face.

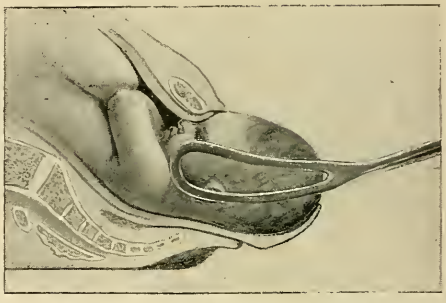


FIG. 212.—Over-distention of the perineum in persistent occipito-posterior deliveries; the nose rests under the pubic arch.

are applied as in the ordinary low operation, and they adapt themselves usually to the sides of the child's head, since the long diameter is nearly or quite in the antero-posterior diameter of the pelvis. In using traction the natural mechanism of delivery in this position should be borne in mind and the forceps be used merely to aid nature. The head becomes arrested in the pelvis because it has undergone extension; therefore, as Barnes aptly puts it, the essential thing to do is to get the occiput down—that is, to restore flexion.

Traction is made downward or horizontally until the forehead emerges sufficiently for the root of the nose to pivot beneath the pubic arch (Figs. 211, 212); the handles are then raised in order to roll the occiput out over the perineum, and they are finally depressed to deliver the face and the chin beneath the pubes. If upward traction is made too soon, the blades will be likely to slip off. Extraction should not be hurried, but plenty of time should be allowed for the moulding of the head and the dilatation of the perineum. The bulky occiput distends the perineum more than does the forehead in occipito-anterior deliveries (Fig. 212); hence more time should be given the perineum to stretch, and special precautions should be taken against rupture. With proper care and attention forceps delivery in occipito-posterior positions

should not be much more difficult or dangerous than in ordinary low operations (see also p. 503, Vol. I.).

In Brow and Face Presentations.—Brow presentations usually flex into vertex or extend into face presentations as the head descends into the pelvis. Forceps should not be applied early in face presentations, but ample time should be allowed for the natural mechanism of forward rotation of the chin. When the face is presenting at the brim, version is preferable to forceps, if manipulation has failed to convert the face presentation into one of the vertex. When the face is descending transversely, forceps should not be used, for traction would be dangerous from pressure on the neck and thorax. When the chin is pointing posteriorly the forceps is contra-indicated; but if the chin has rotated anteriorly and the natural efforts are insufficient to complete delivery, the forceps may be used with advantage. The blades should be applied as nearly as possible to the sides of the child's head, and far enough back to give a good grasp of the occiput (Fig. 213). Traction is made downward until the chin has been brought fairly under the pubic arch; it is then directed gradually forward, and finally upward, as the forehead and occiput sweep out over the perineum. Delivery should be slow after pivoting takes place, because the perineum becomes enormously distended and is apt to tear deeply. Some operators use the forceps to correct faulty positions and to rotate the chin forcibly to the front. Occasionally such manipulations may succeed, but they are always fraught with danger. If an early diagnosis is made by external palpation, there is no good reason why a face presentation should not be converted into a vertex one by external manipulation if the patient be deeply anesthetized; but if rectification is impossible, version is usually easy, and is far preferable to a forceps operation. If labor has gone on for some time, and the head is too low down for rectification or version, the claims of symphysiotomy should be considered. In such a case, if the symphysis be divided the faulty position can be rectified and the head be delivered with less traction, and therefore less compression, while the maternal soft parts are less exposed to serious bruising and laceration. External palpation, external rectification of faulty positions, and the modern symphysiotomy have greatly altered the old ideas respecting forceps operations and have vastly improved the results (see also p. 512, Vol. I.).

FIG. 213.—Forceps extraction in a face presentation: the chin has passed the arch, and appears at the vulva, while the face is still distending the pelvic floor.

In Breech Presentations.—In certain difficult breech presentations, when it is impossible to bring down a foot, the forceps sometimes succeeds. When the limbs are extended and the feet are on a level with the shoulders (*mode des fesses*) the forceps proves particularly serviceable. Tarnier's axis-traction

forceps gives a better hold than the ordinary forceps and is less likely to slip, since it enables traction to be made more certainly in the pelvic axis. The blades should be applied over the trochanteric or bisiliac diameter, in order that the pelvis may be grasped as nearly as possible transversely (Fig. 281, Vol. I.). If applied otherwise, the blades are apt to slip, causing injury to the fetal abdomen and genitals. Traction should always be made gently and in the pelvic axis; the pendulum movement is to be avoided. Care should also be taken not to compress the blades too forcibly, for fear of fracturing the iliac bones. The forceps, properly applied, will injure the child far less than the fillet or the blunt-hook (see also p. 528, Vol. I.).

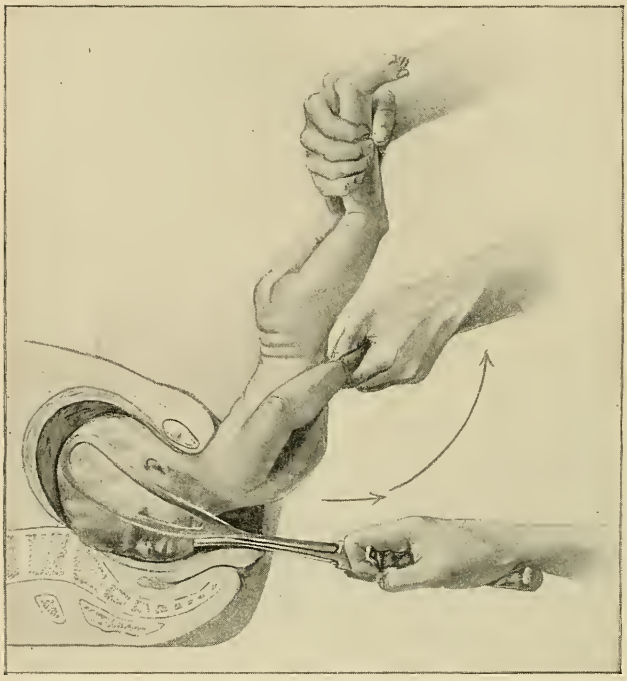


FIG. 214.—Forceps extraction of the after-coming head: the arrows show the direction of traction.

To the After-coming Head.—In breech cases, when there is difficulty in delivering the head quickly enough to save the child's life, the forceps is sometimes of great use as a *dernier ressort.* In such cases it is a question whether the head can be delivered soon enough to prevent the child from asphyxiating, not whether possibly it might not be delivered after a time by some other means. When ordinary measures have failed and the child's life is in imminent danger, the forceps should be tried. The old rule is to apply the blades along the child's abdomen; if the occiput is to the front, the child's body is lifted up over the pubes and the blades are applied to the head from beneath (Fig. 214); if the face is to the front, the child's body is carried back over the perineum and the blades are applied from above. Traction is made in the direction that will secure speediest delivery. It will sometimes be found more convenient to reverse the rule and to apply the blades along the child's back, especially if the perineum is very long and rigid. The best plan is to apply the blades wherever there is most room. The application of forceps to the after-coming head is the only means of saving the child when the cervix has retracted about the neck and resists all efforts to deliver by traction upon the body.

To the Severed Head.—When decapitation has been performed, it is sometimes difficult to deliver the head. If an assistant brings the head down over the brim and holds it firmly there, the operator can generally pass his hand into the uterus and guide the blades over the head until they grasp it securely. Care must be taken that no spicules of bone protrude to lacerate the parturient canal during extraction.

Application of Forceps in the Left-lateral Position (English Method).—The patient is placed across the bed, lying on her left side, with both knees drawn

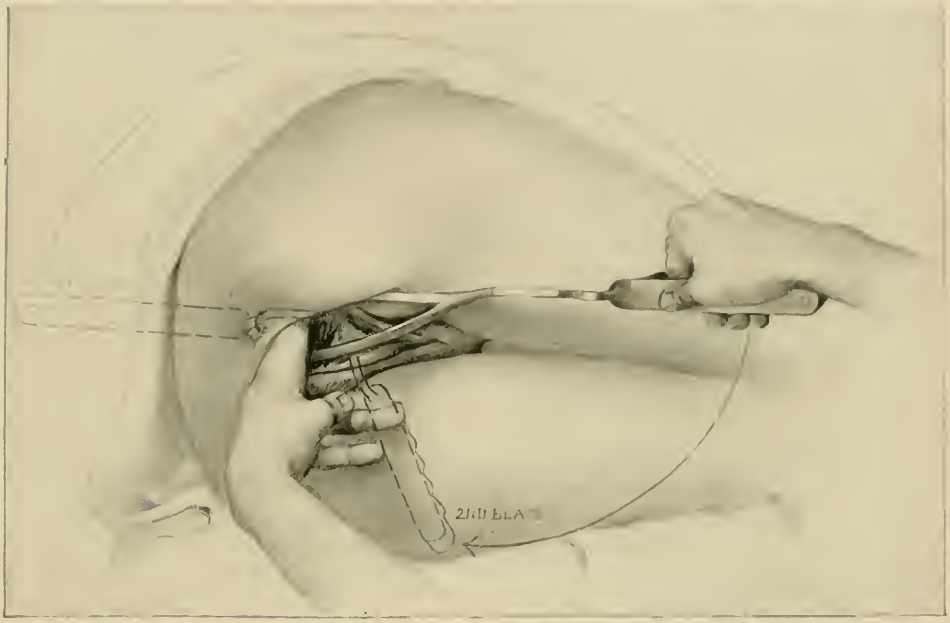


FIG. 215.—Application of the forceps in the left lateral position: the arrows show the course taken by each blade.

up and the hips brought well over the right edge of the bed. Both blades are passed with the right hand, while the left guides them around the head. Two fingers of the left hand are passed along the posterior wall of the vagina (Fig. 215), through the cervix to the presenting part, and are pushed up as far as possible. With the finger-tips pivoting upon the head-globe, the backs of the fingers and the back of the hand press back the cervix, the posterior vaginal wall, and the perineum as far as the coccyx will permit. The lower blade, held in the right hand with the beak downward and the cephalic curve directed forward, is passed horizontally along the guiding fingers of the left hand until its tip is directed over the convexity of the head-globe. The handle is then raised and carried backward along the mother's right thigh, which movement causes the point of the blade to travel around the *under* surface of the head-globe. Finally the handle is carried backward and downward until the shank falls behind the operator's left wrist, thereby keeping the blade from shifting during the passage of the second blade. An assistant is not required to hold the first blade, as in the dorsal operation. The upper blade, held in the right hand in precisely

the same way as in the dorsal operation, is then passed horizontally along the guiding fingers of the left hand, above the shank of the first blade, until the finger-tips direct it over the convexity. The handle is then lowered and carried backward along the mother's left thigh; this movement causes the blade to travel around the *upper* surface of the head-globe until it lies in the right ilium. The left hand is then withdrawn from the vagina, and a handle is seized in each hand. The handle of the first blade is made to retrace its course a little until it lies directly over the second blade; with a little maneuvring the blades can easily be locked if the case is suitable for the forceps operation. When the blades are locked one handle should look vertically upward, the other vertically downward. When extraction is about to begin the handles are carried well back against the perineum in order to make traction approximately in the axis of the brim. As the head descends the handles are carried more and more forward. The introduction of the blades is somewhat more complicated than in the dorsal position, but in extraction the lateral position has the great advantage of enabling the operator to estimate more accurately the line of traction, and to modify it more easily as circumstances may require. During extraction in the dorsal position the handles describe a vertical arc from below upward; in the lateral position they describe a horizontal arc from left to right.

The amount of tractile force can be graded better, and the line of traction can be kept more easily in the pelvic axis, when the operator is pulling around the horizontal arc of the lateral position than when pulling at a disadvantage around the vertical arc of the dorsal position. As the tendency is generally to pull too much and too soon to the front, and as modern beds are low and the patient's pelvis is usually on a lower level than the arms of the operator, the dorsal position is apt to increase the tendency to pull too much to the front. A certain amount of force is consequently wasted against the front wall of the pelvis, and more force is required to effect delivery than if the pull had been in the proper direction; moreover, the perineum is more fully in view throughout the operation, and can more easily be safeguarded, than in the dorsal position. In private practice the lateral position is often more convenient, since a skilled assistant is not required. On the contrary, the dorsal position permits the use of pressure on the fundus to supplement the operator's tractile force, and there is less loss of power from want of coincidence of the uterine and pelvic axes. Each method has its advantages as well as its disadvantages; in some cases it may be more convenient to use one, and in some the other method, or even occasionally to change from one to the other during the course of the operation.

Symphysiotomy (*σύμψυσις*, symphysis, *τομη*, a cutting) is an operation for division of the pubic symphysis. Its object in obstetrics is the enlargement of the pelvic cavity to facilitate delivery in narrow pelves.

History.—The first symphysiotomy of which we have any knowledge was performed in 1644 by Jean Claude de la Courvée, a French physician practising in Warsaw, Poland. This operation was performed after the death of the

mother for the purpose of saving the child. A similar post-mortem section was performed in 1766 by Joseph Jacques Plenck of Hungary. To Jean René Sigault of Angers, France, belongs the credit of originating the operation as applied to the living subject. The idea seems to have been suggested to him, however, by a work of Severin Pineaud, first published in 1598. While still a student of medicine, Sigault had several times practised the operation of symphysiotomy on the bodies of women who died in labor, and in 1768 he read a memoir upon the subject before the Royal Academy of Surgery at Paris, proposing the division of the pubic joint as a substitute for Cesarian section. His proposal for a time met with little favor, since his first experiments, which were performed on bodies that had become rigid from being too long dead, failed to show an amount of separation sufficient to effect any material gain in the pelvic diameters.

The first symphysiotomy performed clinically is credited to Domenico Ferrara, who had become familiar with the views of Sigault while in Paris (Robb). He operated in Naples in 1774. The mother died. Sigault's first operation on the living woman was performed in Paris, Oct. 1, 1777, with the assistance of Prof. Alphonse Leroy, who had become interested in the subject, and in common with Sigault had studied the operation on the cadaver. The woman's recovery was tedious and complicated with a urinary fistula, yet both mother and child survived.

At that time Cesarean section was almost uniformly fatal, and the new operation, which seemed destined to replace it, was received with enthusiasm. In the next decade thirty-five symphysiotomies were done in various parts of Europe. Imperfect knowledge of pelvimetry and of the proper limits of the operation led to its frequent misapplication; the technic, too, was faulty. Urethral and vesical injuries, sepsis of the pelvic organs, caries of the bones, and non-union of the joint were frequent results of the operation, and it soon began to lose favor. Symphysiotomy was bitterly denounced by Baudelocque and certain other obstetric authorities of the time, and in 1858 it had fallen into general disrepute. During the period between 1777 and 1866 there were, according to Harris, one hundred symphysiotomies, with a maternal mortality of 31 per cent. and a fetal mortality of 65 per cent.

From 1818 to 1891 symphysiotomy was almost exclusively confined to Naples. Though it at no time wholly died out, it was practically obsolete from 1858 to 1866. In the latter year it was taken up by Prof. Ottavio Morisani, of Naples, who first operated in January, 1866, saving both mother and child. Encouraged by this success, he become deeply interested in the cause of symphysiotomy, and to his labors in its behalf we are indebted for its general re-adoption. Largely as the result of his efforts the technic was improved and the mortality greatly reduced. The first fifty Neapolitan operations done by Morisani and his followers saved 80 per cent. of the mothers, and later, when the operation came to be performed under modern antiseptic methods, the mortality was still smaller. The results were frequently published, yet for a quarter of a century the successful work that

was being done in Naples attracted little or no attention outside of Italy. Until 1892 the operation was almost universally condemned or was ignored by obstetric writers in other parts of the world. That year was a memorable one in the history of symphysiotomy. In January, 1892, it again secured a footing in Paris. At that date Spinelli, a pupil of Morisani, published in the *Annales de Gynécologie* a memoir with a detailed account of twenty-four cases. Moreover, Pinard, the editor of the journal, had seen the operation demonstrated upon the cadaver by Spinelli. He at once became an earnest champion of symphysiotomy, and advocated its claims in a paper upon the subject before he had performed it. He first operated in February, 1892, and in little more than a year nineteen symphysiotomies were performed by himself and his assistants, saving nineteen women and sixteen children. Within a few months after the publication of his first successes the operation had spread to the rest of the Continent and over both hemispheres.

In the United States, Dr. Robert P. Harris, of Philadelphia, had long upheld the cause of symphysiotomy, and had repeatedly brought the subject to the attention of the English-speaking profession. In September, 1892, he presented a paper to the American Gynecological Society, entitled "The Remarkable Results of Antiseptic Symphysiotomy."[1] From this time dated the introduction of symphysiotomy into America. On the 30th of September, 1892, the operation was performed by Jewett, of Brooklyn, and three days later by Hirst, of Philadelphia. Other operations followed in rapid succession in various parts of the country.

Results of Symphysiotomy.—In 210 symphysiotomies performed since 1886, when the operation began to be done under Listerian precautions, there were, according to Neugebauer,[2] 27 maternal deaths, a mortality of 12.85 per cent. Of the children, 20.2 per cent. were lost, including those that died shortly after birth. Under favorable conditions, however, and at the hands of skilled operators, the death-rate has been almost *nil*. Pinard lost but 11 per cent. in 90 operations, and Zweifel none in his first 31. Bar in 23 symphysiotomies saved all the mothers and all the children. Küstner in 7 symphysiotomies had no maternal or fetal deaths. Jewett, of Brooklyn, in 8 operations lost 1 of the mothers by bronchopneumonia and all the children were delivered alive, though not all survived the first month.

In the first 72 operations in the United States the maternal death-rate was 14 per cent. and the infantile mortality was 26 per cent. But these results cannot be taken as fairly representing the capabilities of symphysiotomy. The operations were done by a large number of operators of varying degrees of skill and for the most part of little or no experience in symphysiotomy. In many cases the conditions were unfavorable for pubic section, and most of the deaths were due to causes wholly independent of the method of delivery.

In Italy, at the hands of Morisani and his followers, in 55 modern symphysiotomies 3.5 per cent. of the mothers and 5.5 per cent. of the children

[1] *American Gynecological Transactions*, vol. xvii.

[2] *Ueber de Rehabilitation der Schamfugentrennung oder Symphyseotomie*, etc., 1893.

were lost. Pinard, of Paris, in his first 90 operations had but 11 per cent. of maternal deaths. The total number of cases in the Baudelocque clinic (1892–94) was 49; four women and five children died. Zweifel, of Leipsic, operated 31 times, saving all the mothers and all but 4 of the children. It would seem that in properly selected cases and with skilled operators the death-rate for the women should not, at the most, exceed three or four in a hundred.

In the proportion of mothers saved the record of symphysiotomy compares favorably with that of Cesarean section. In 79 Cesarean operations performed in the United States since the adoption of the Sänger method, 35.49 per cent. of the mothers and 12.69 per cent. of the children were lost. Zweifel's results in 37 symphysiotomies with no maternal deaths and Morisani's 55 cases with a loss of 3.5 per cent. of the mothers have not been equalled by Cesarean section. In the best Cesarean record, which is that of Leipsic, three women were lost in 54 operations—a mortality of 5.5 per cent. The proportion of children lost under symphysiotomy has greatly exceeded that of the Cesarean operation.

In premature artificial labor under approved modern methods the maternal death-rate should not be more than 2 or 3 per cent., but the mortality for the children is very great. Two-thirds of the children perish, if we include those who die within a few days or weeks after birth.

In the early history of symphysiotomy suppuration of the symphysis and of the sacro-iliac joints, caries of the pubic bones, and non-union were not infrequent results of the operation; but they were for the most part faults of the crude surgery of that period, rather than of the operation itself. In several recent cases some mobility of the pubic bones has been noted when the women began to walk, but rarely more than is occasionally observed after difficult forceps deliveries and even after spontaneous births. The woman's powers of locomotion are not necessarily crippled by slight looseness of the joint. Frommel, however, reported a case in which a sequestrum of bone an inch in length came away, and there was persistent failure of union, with inability to walk after three months. As a rule, under a rigid asepsis, and with complete immobilization of the pelvis during convalescence, the restoration of the symphysis in women not previously infected has been complete. Vesical and urethral injuries have been reported in several instances. They are liable to occur not only from the knife, but also from pinching the urethra and bladder between the bones when the latter are brought together. These accidents, as Morisani declares, are faults of the operator, and should be prevented. Troublesome hemorrhage frequently happens, either from the incision or from lacerations. It is especially liable to be encountered on division of the subpubic ligament, owing to the vascularity of the structures about the lower end of the symphysis. Lacerations of the corpus cavernosum of the clitoris, with more or less bleeding, not infrequently occurs. Hemorrhage, however, is controllable by use of pressure and the hemostatic suture. Packing the wound and the vagina with iodoform gauze generally suffices. The vagina, particularly the anterior wall, is exposed to laceration during the

extraction of the child. In septic conditions of the passages the latter injuries may assume no little importance by opening avenues for the possible infection of the symphysis.

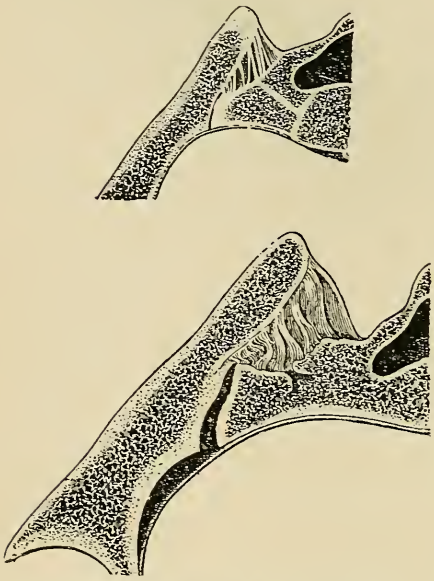


FIG. 216.—Separation of the sacro-iliac joint on opening the pubic symphysis (Farabeuf).

Anatomical Limitations.—The gain of space attainable in symphysiotomy is mainly determined by the mobility of the sacro-iliac joints (Fig. 216). Experiments on the cadaver by Wehle and numerous other observers show that in non-puerperal pelves the anterior sacro-iliac ligaments rupture at different degrees of pubic separation, ranging from about 4 to 9 centimeters ($1\frac{1}{2}$ to $3\frac{1}{2}$ inches), the results varying with the age and the physical condition of the subject. In pelves from puerperal women a separation of 8, or even 9, centimeters is possible without injury to the sacro-iliac articulations. In two operations by Caruso an interpubic space of 8.5 centimeters ($3\frac{2}{5}$ inches) in one and 9 centimeters ($3\frac{3}{5}$ inches) in the other was obtained with no bad results; 6.5 centimeters ($2\frac{3}{5}$ inches) may be regarded as an entirely safe limit of pubic separation. With an interpubic

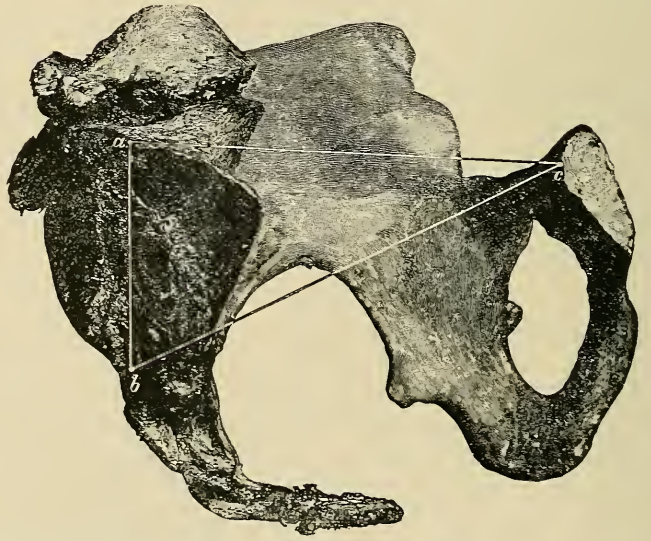


FIG. 217.—Left innominate bone: *a*, *b*, axis at the ilio-sacral joint upon which the bone rotates when the pubic end is abducted (Wehle).

opening of 6 centimeters ($2\frac{2}{5}$ inches), the conjugata vera gains 1.2 centimeters ($\frac{1}{2}$ inch), the transverse 1.9 centimeters ($\frac{3}{4}$ inch), and the oblique diameters 2.5

centimeters (1 inch). With a separation of 7 centimeters ($2\frac{3}{4}$ inches), which is possible under gentle pressure without laceration of the sacro-iliac ligaments, the gain in the conjugata vera is 1.5 centimeters ($\frac{3}{5}$ inch).

FIG. 218.—Sacrum: *a b*, *a b*, axes on which the innominate bones hinge. Owing to the wedge-shape of the sacrum, they run from above downward and inward (Wehle).

Wehle[1] called attention to the fact that when the pubic bones are separated the sacro-iliac joints rotate upon an oblique line running from above downward and from without inward, and that in consequence the ends of the pubic bones move downward as well as outward when the joint is opened (Figs. 217–223). A separation of 3 centimeters ($1\frac{1}{5}$ inches) causes a descent of 2 centimeters ($\frac{3}{4}$ inch), which is still further increased by the downward pressure of the fetal head during delivery. This descent of the pubic bones adds mate-

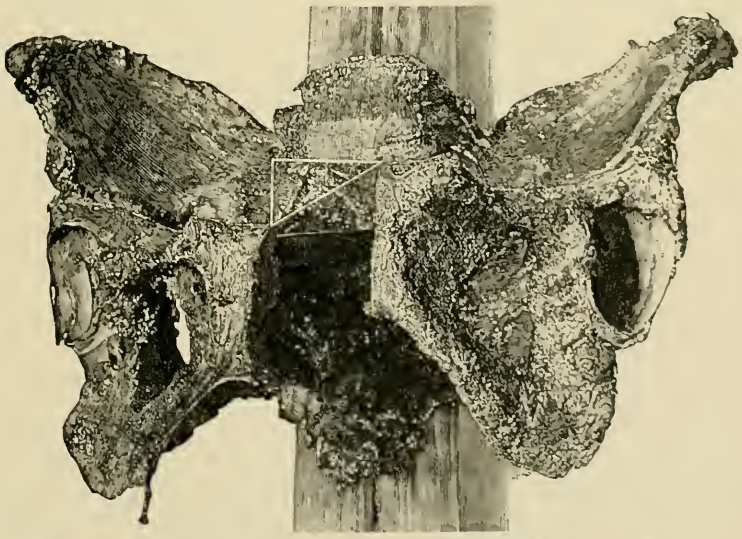


FIG. 219.—Moist preparation of pelvis attached by sacrum to a post; left innominate bone immobilized; right bone abducted. Shows downward movement of pubis on abduction (Wehle).

[1] *Arbeiten aus der Königlichen Frauenklinik in Dresden*, Band i., 1893.

rially to the amount of pelvic space gained (Figs. 219, 220, 222). All the

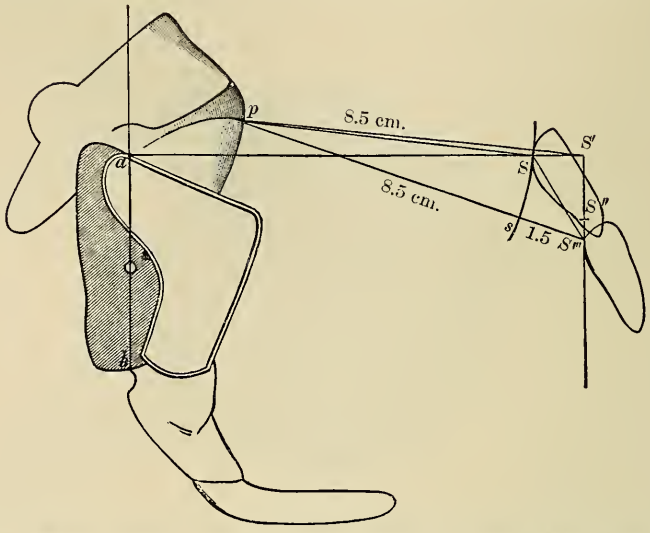


FIG. 220.—The effect of descent of the pubic bones on the gain in length of sacro-pubic diameter. By mere separation of bones, the gain in conjugata vera would be $S\,S'$; with added effect of descent it is S'', S''' (Wehle).

lines running from the promontory to the anterior half of the linea ilio-pectinea are elongated more than by mere separation of the pubic bones. But this is

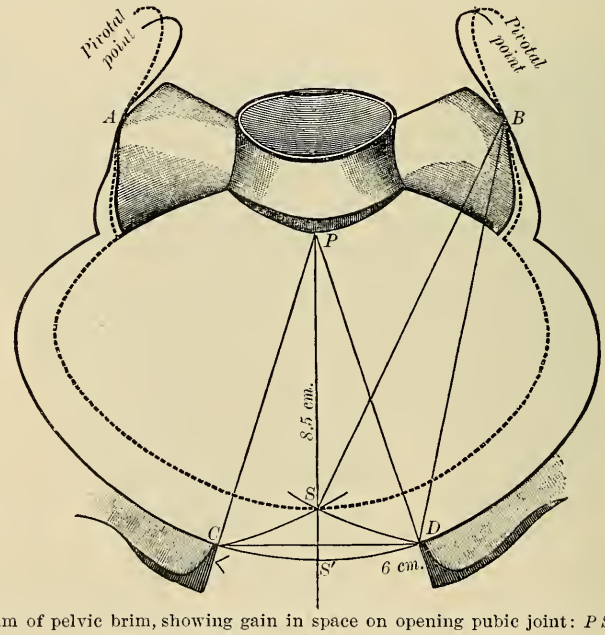


FIG. 221.—Diagram of pelvic brim, showing gain in space on opening pubic joint: $P\,S$, conjugate joint closed; $P\,S'$, conjugate joint open 6 cm. (Wehle).

not all. As the bones recede from each other the anterior parietal bos projects nearly a centimeter into the pubic interspace. The increase in the conjugate

diameter by opening the pubic joint to the extent of 6.5 centimeters (2⅔ inches) amounts, therefore, in effect, to about 2 centimeters (¾ inch).

Indications.—In general, symphysiotomy is applicable in obstructed labor in which the delivery of a living, viable child may be rendered possible by a

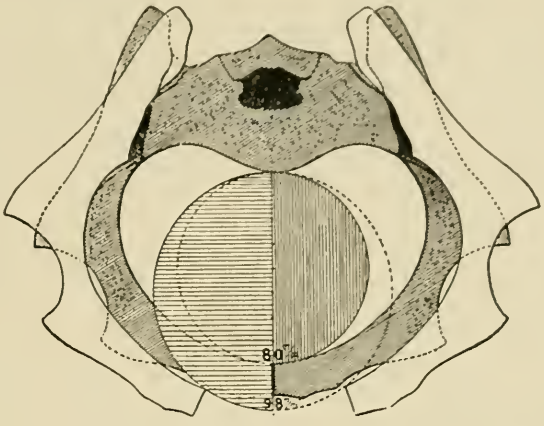


FIG. 222.—Diagram of pelvic brim, showing gain of space on separation of symphysis. Pubic joint closed, pelvic cavity admits a sphere 80 mm. in diameter; joint opened 6 cm., the cavity admits a sphere 98 mm. in diameter (after Farabeuf).

moderate expansion of the pelvis. In the simple flattened pelvis the limits of the operation may be computed from the data already considered. The biparietal diameter of the average fetal head is 9.5 centimeters (3¾ inches). It is reduced by compression during the birth to about 9 centimeters (3½ inches).

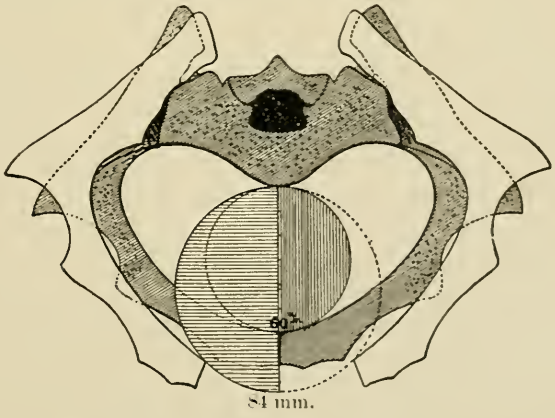


FIG. 223.—Diagram of pelvic brim, showing gain of space on separation of symphysis. Pubic joint closed, the pelvic cavity admits a sphere 60 mm. in diameter; joint opened 6 cm., the excavation admits a sphere 84 mm. in diameter (after Farabeuf).

After full separation of the symphysis the parietal bos projects into the interpubic space, and this in effect shortens the biparietal diameter to the extent of nearly a centimeter more. A conjugate of 8 centimeters (3⅕ inches) will therefore be required for the passage of the head. Since a pubic separation of 6 centimeters (2⅔ inches) affords a gain of 1.2 centimeters (¾ inch) in the antero-

posterior diameter, delivery under symphysiotomy may be done in simple flat pelves with a conjugate not below 6.8 centimeters ($2\frac{5}{8}$ inches). Clinically, however, at least in America, 7 centimeters ($2\frac{3}{4}$ inches) is generally adopted as the minimum conjugate for pubic section.

At its upper limit the field of symphysiotomy begins where that of forceps and version ends. The latter operations become dangerous to mother and child in contractions below 9 centimeters ($3\frac{1}{2}$ inches), conjugata vera. Not only is the maternal and the fetal mortality greatly increased under prolonged and difficult extraction by forceps or version, but mental and physical infirmities, resulting from intracranial injuries, are also common in the children who survive. With a normal head, then, the field of symphysiotomy in simple antero-posterior contraction lies between 7 and 9 centimeters ($2\frac{3}{4}$ and $3\frac{1}{2}$ inches), conjugata vera. In generally-contracted pelves the operation may usually be performed with advantage with a conjugate between 8.2 and 10 centimeters ($3\frac{1}{4}$ and 4 inches).

The limitations of symphysiotomy, however, cannot yet be regarded as absolutely settled. Views differ according to the varying success of different operators. More extended experience will be required to determine fully the place which the operation shall finally hold in obstetric surgery.

It is evident that the safe choice of procedure must depend upon an accurate estimate of the relative size of the head and the pelvis, and this is possible only for the expert well trained in pelvimetry and in the methods of measuring the fetal head. The capacity of the pelvis to receive the head should be judged not only by direct measurements, but also by trying whether the head can be crowded into the excavation or can be made to engage by careful traction with the forceps.

Symphysiotomy has been proposed for delivery in impacted and irreducible mento-posterior face cases and in occipito-posterior positions with impaction. In such emergencies and in irreducible brow presentations, provided all other conditions are favorable for both mother and child, pubic section would seem particularly applicable, since the small extent of pubic separation required would entail a minimum risk to the mother.

The symphysis has been opened to facilitate delivery by embryotomy on the dead child in absolute contraction of the pelvis. The combination of symphysiotomy and premature labor seems to the writer of doubtful utility. The object is to extend the limits of the former procedure into the higher grades of contraction, but the combined risks of both operations can scarcely offer any advantage over Cesarian section, especially for the child. Symphysiotomy is obviously contra-indicated in ankylosis of the sacro-iliac joints, and therefore in the Robert and the Naegele pelvis.

Method of Operation.—The instruments and materials required in symphysiotomy are a common scalpel, a slightly curved, narrow-bladed, probe-pointed bistoury, the Galbiati knife or the modified Galbiati knife of Harris, curved needles, needle-forceps, catgut and silk sutures, a few hemostatic forceps, and a yard or two of sterile gauze. A strongly curved grooved

guard or director, two small dull retractors, and one sharp-pointed retractor will be found useful. Three assistants are needed—one to give the anesthetic, two to hold the knees and render such other assistance as the operator may require. The proper time for operation is at the close of the first stage of labor. In emergency the dilatation of the cervix when already well advanced may be completed by the hand or by the use of Barnes' bags. In certain cases advantage may be gained by dividing the symphysis before full dilatation in order to promote the expansion of the cervix by permitting the head to sink into the excavation. Immediately before the operation examination should be made for the auscultatory evidence of fetal life by listening over the abdomen. Before finally deciding upon symphysiotomy the mobility of the sacro-iliac joints should be tested by strongly flexing and extending the thighs and by rotating the knees outward. The patient is anesthetized and placed upon a firm table with her knees drawn up and held apart. The pubes should be shaved and the abdominal walls be cleansed and disinfected as for celiotomy. The vulva should be rendered as nearly aseptic as possible, since the pubic wound is exposed to infection through lacerations of the anterior soft parts. The bladder is emptied with a catheter. The location of the symphysis is determined by searching for the depression at its upper margin. The slight motion of the pubic bones produced by alternately flexing and extending the thighs helps in finding the joint. It must be remembered that a precisely central position of the symphysis is exceptional in deformed pelves. The incision is made in the plane of the symphysis. It begins from 2.5 cm. to 5 cm. above the joint, and ends below at a point just above the clitoris. The linea alba is laid bare, and the prepubic structures are divided down to the symphysis. The wound is held open with retractors. The suspensory ligament of the clitoris is divided by a transverse incision, with care to avoid the dorsal artery of the clitoris. The clitoris is drawn down by means of a sharp-pointed retractor caught in the tissues just above it. The pubic arch is laid bare by separating with the point of the scalpel the subpubic ligament and the deep perineal fascia from the bones for an inch or more on either side of the symphysis. The linea alba is incised, and a finger passed down behind the joint separates the retropubic structures from the bones. A strongly curved broad grooved director is passed behind the symphysis close to the bones, either from above or below, the finger serving as a guide. The director or guard protects the urethra, the neck of the bladder, and the retropubic blood-vessels from injury while dividing the joint. It renders unnecessary the use of a sound or catheter for holding the urethra aside. Upon the director the interpubic disk is divided with the scalpel or with probe-pointed bistoury from behind forward or from before backward. At this juncture the assistants support the lateral halves of the pelvis firmly to prevent the pubic bones from springing too widely apart. The separation must not be permitted to exceed 7 cm. ($2\frac{3}{4}$ inches). The wound is protected with sterile gauze, and the child extracted. Forceps are employed

if the head presents. Care is needed to prevent too great strain upon the anterior soft parts, and consequent laceration of these structures during delivery. The liability to this accident is especially great in breech extraction, since the delivery must be completed rapidly. When anterior laceration seems imminent, it should be prevented by double episiotomy incisions. Rarely the woman may be permitted to deliver herself with the aid of expressio fœtus. As a rule, it is better to terminate the labor at once. The patient is thus spared a prolonged exposure of the operation wound and the attendant risk of infection.

After extraction of the child and placenta the pubic bones are brought firmly together, the bladder and urethra meantime being held backward to

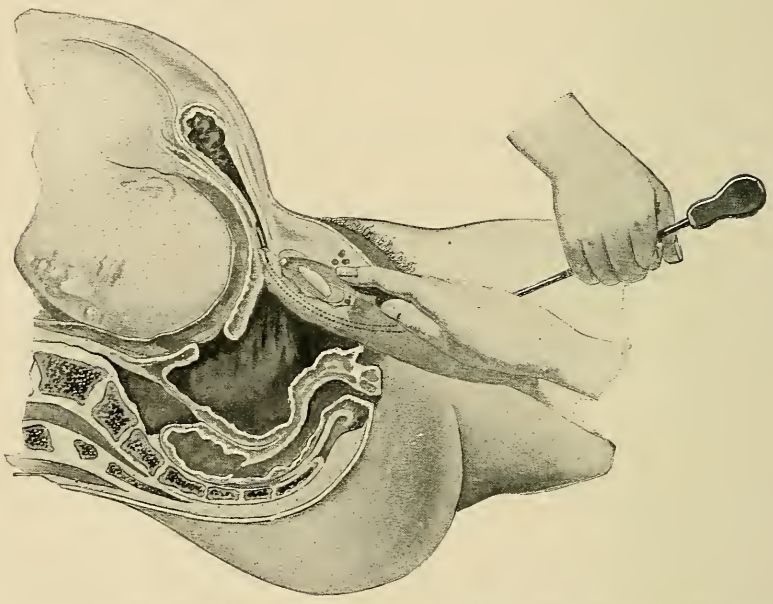


FIG. 224.—Symphysiotomy: subcutaneous operation; the left index-finger within the vagina and behind the symphysis (side view).

prevent injury by pinching between the bones. The prepubic fibrous structures are sutured with three or four interrupted stitches of catgut, and the remaining portion of the wound closed with silkworm-gut, passed from within outward. If preferred, the catgut sutures may be dispensed with, the silkworm-gut sutures being made to include the ligamentary structures in front of the pubic bones. Or the deeper portion of the wound may be closed with buried catgut and the skin with the subcuticular suture. The wound is dressed as in other celiotomies.

While the technic just detailed, it is believed, will be found most satisfactory, other methods are by some operators preferred. The symphysis may be divided with the blunt-pointed bistoury, the finger behind the joint serving in place of the director as a guard. Bleeding, which is sometimes

profuse, is controlled by gauze packing. The sickle-shaped knife of Galbiati may be substituted for the bistoury. It is passed behind the symphysis, hooked under the pubic arch, and drawn upward through the joint. Morisani operates by the subcutaneous method through a small incision entirely above the symphysis. Ayers, of New York, advocates a subcutaneous operation conducted as follows: The patient is placed upon her back upon the operating-table, with the knees drawn up and out. An assistant, standing at the patient's left, raises the clitoris and elevates the labia. The operator embraces the upper and lower borders of the symphysis with the thumb and finger of the left hand, then pierces the mucous membrane with an ordinary scalpel just below the clitoris, and pushes the blade, with the

FIG. 225.—Symphysiotomy: subcutaneous operation; the left index-finger within the vagina and behind the symphysis (front view).

edge against the symphysis, along the face of the joint to near the top, to make a channel for the bistoury (Figs. 224, 225). With a sound passed into the bladder the assistant holds the urethra to the left of the median line, when the operator passes his left index-finger within the vagina behind the symphysis. A bistoury is passed through the opening made to the top of the symphysis, where it meets the tip of the left index-finger. The knife is pressed down through the joint to about one-quarter of an inch of the under border. It is then taken out and reintroduced with the tip just under the lower border, and the remainder of the joint severed from below up. During the division of the joint a second assistant supports the iliac crests. In bringing the severed bones together the sound should be reintroduced.

and used to hold back the urethra and bladder from being caught and pinched between the bones. No sutures are needed.

In rare cases, owing to ossification of the joint, it has been found necessary to replace the knife with a chain-saw or a finger-saw. It is probable that in some assumed instances of such anomalies the real difficulty has been failure to find the joint.

After-treatment.—Vaginal and vulvar lacerations should be closed by suture. The bladder and the urethra should be examined for possible injuries. A large absorbent pad may be placed over the vulva. The patient is put in bed on her back, with the knees lightly tied together and the limbs outstretched. This position best favors apposition of the sundered bones, and should therefore be maintained until reunion of the joint is established. Absolute immobilization of the pelvis during convalescence is essential to immediate and firm union of the joint. Many operators have trusted to a strong muslin binder. A canvas belt provided with straps and buckles for tightening makes a satisfactory dressing. The broad part of an Esmarch bandage has been used. One operator has used a wire cuirass to keep the bones together. Gueniot proposes an apparatus which he calls an "iliac compressor," consisting of lateral plates well padded, compression being applied by means of anterior and posterior straps. Pinard has made use of a trough-shaped bed for retention of the bones. A satisfactory plan, which has been adopted by several American operators, consists in the use of adhesive straps of rubber plaster, supplemented with the muslin binder. Three broad strips of plaster are carried across the abdomen from one wing of the pelvis to the other above the wound. The muslin binder is pinned tightly over the plaster straps. The adhesive straps are particularly useful as a partial support to the pelvis while the muslin bandage, which frequently becomes soiled, is being changed. This may be supplemented by the trough-shaped bed of Pinard. The writer has improvised such a bed by placing beneath the mattress two sand-bags at the required distance apart and long enough to reach from the shoulders below the hips.

For evacuation of the bowels or the bladder the patient may be lifted upon the bed-pan, the nurse seizing the hips over the trochanters. The use of the catheter is frequently necessary for the first few days, but it should be avoided if possible. The dressing of the pubic wound may remain undisturbed for a week unless it becomes soiled by the lochial discharges. A constant object of solicitude is the pelvic bandage. It should be examined several times daily, and be tightened as often as the least slackness is noted. It is exposed to soiling with urine and fecal discharges, and it is only by the utmost vigilance that proper cleanliness can be maintained. The simple muslin binder must be replaced frequently with a fresh one. While it is being changed the lateral halves of the pelvis should be supported firmly by an assistant. The bowels should be kept open as in other cases. The pelvic bandage is to be worn from four to six weeks. The patient may

usually leave her bed at the expiration of three weeks, and leave her room by the end of a month.

An excellent apparatus for retention of the pubic bones and for facilitating the care of the patient during convalescence is Ayer's hammock bed. As shown in the accompanying illustration (Fig. 226), the poles lying upon the top of the bed support a canvas band 16 by 57 inches in size, with a hole at the dependent part 6 inches in diameter. This canvas, lined with an inch padding of cotton and gauze, supports the pelvis, bringing the pubic bones into coaptation, without compression, and permits free discharge through the opening below into a flat bed-pan which is held snugly against the protruding buttocks by a second canvas stretched across the lower poles

Fig. 226.—Ayer's hammock bed.

of the bed. It is necessary to apply some pressure to the buttocks to prevent swelling and subsequent cutting at the edge of the canvas hole. Elasticity is given the under canvas support by having it anchored to the lower iron of the bed with rubber tubing. The remainder of the patient's body is supported by a second hammock, which consists of two pieces of canvas, for the upper and lower portions of the body respectively, each 31 by 30 inches in size. These are held stretched like a cot, and are covered by two mattresses of the same size. This lower hammock can be raised or lowered to meet the level of the pelvic canvas. The degree of pubic compression can be varied by moving the upper poles nearer, to increase it, and farther, to lessen it. The pelvic canvas is hung to the upper poles by sleeping-car hooks, as it is necessary to change it for a clean one every few days. When

making this change the pelvis is supported by two 3-inch wide bands swung to the upper poles and by the hands of an assistant. The pelvic canvas should also be moved an inch each day higher and lower alternately, to prevent cutting of the skin. To wash the buttocks and irrigate the vagina the lower canvas holding the bed-pan is removed, and the parts reached from underneath the pelvic canvas through its opening.

Dickinson hangs the patient up in her own binder. A stout cane or stick is passed lengthwise of the patient, beneath the front of the loosely pinned binder. To one projecting end is tied a piece of clothes-line. This rope runs over a large hook screwed into a beam in the ceiling, and down to the other end of the stick. The woman's pelvis swings just clear of the bed. To pass the bed-pan or to change the bed-linen the patient is lifted by means of the rope. A pillow beneath the knees and lateral pillows add to the patient's comfort.

Cesarean section is the operation of removing the fetus from the mother by opening the abdomen and incising the uterus. Among the ancients it was done immediately after the death of the mother; but not until the fourteenth or the fifteenth century is there any record of the operation being performed upon a living mother. The maternal mortality was so great that the operation was condemned by Ambroise Paré, Mauriceau, and others, and for a long time was practically abandoned. The cause of death was usually hemorrhage or sepsis. The uterine wound was not closed, because it was thought that the alternate contractions and relaxations of the uterus would make the stitches tear out. The uterine wound was left gaping, and eventually closed by adhesive inflammation to the abdominal wall. The cicatrix which was formed varied greatly in depth and strength, was extremely liable to subsequent rupture, and occasionally permitted hernia to take place. The use of the uterine suture was advocated and practised in the beginning of the present century; nevertheless, the mortality remained high until Porro (1876) supplemented the ordinary section by amputating the uterus and including the stump in the abdominal suture. But the greatest advance was made in 1882 by Sänger of Leipsic, who proposed the complete closure of the uterine wound by multiple sutures; to him is in great measure due the credit of perfecting the modern operation. Its success is mainly attributable to three causes: (1) A strict antiseptic technique; (2) complete closure of the uterine wound by multiple sutures; and (3) the deliberate selection of the operation before the beginning of labor, and its performance before the patient's strength has been exhausted or her passages infected by repeated examinations and fruitless attempts to deliver by forceps or by version. Since the introduction of the Sänger operation craniotomy upon the living child has been wellnigh abandoned in France, and even the mutilating Porro operation has been restricted within very narrow limits.

Indications.—Cesarean section may be performed in the interest of the mother or of the child when safe delivery by version or by forceps is impossible. If the mother is moribund and the child is still alive, its life will depend upon a speedy delivery; with the mother's consent the operation may be performed

to save the child. But the cases of real difficulty are those in which the delivery of a living child is impossible in any other way than by Cesarean section, yet the mother might be delivered with comparative safety by performing a craniotomy. Is it permissible to destroy the child in order to save the mother? Has she the right to refuse Cesarean section and to demand craniotomy in her own interest, or to insist upon whatever operation will give her the best chance of recovery, regardless of her child? Has the obstetrician the right to weigh one life against another, and decide to take the one by craniotomy or to jeopardize the other by Cesarean section? These are serious questions, with important moral and religious bearings, which the physician should not be called upon to decide. He should fortify himself by consulting with a *confrère*, and then, having laid the medical aspects of the case plainly before the patient and her friends, should leave the ultimate decision to them. Undoubtedly his first duty is to his patient, but he is not called upon to over-persuade her or to override her wishes. After a serious accident a surgeon may recommend the amputation of a limb as the only means of saving life, and may even feel compelled to retire from the case if his advice is not taken; but he has neither the moral nor the legal right to amputate the limb against the will of his patient. The indications for Cesarean section are generally classed as *absolute* and *relative*.

Absolute Indications.—The indication is absolute when it is impossible to extract the fetus, either living, dead, or mutilated, through the natural passage. This may be the case in extreme pelvic contraction from arrested development, rickets, or osteomalacia, or where the passage is blocked by tumors of the pelvis (osseous) or of the uterus and the soft parts (carcinoma, fibroma, etc.). The modern symphysiotomy has narrowed the limits of Cesarean section somewhat, so that now the indication is not considered absolute unless the conjugate is 6 centimeters (2⅓ inches) or under, the child being well-developed and at full time. Some authorities do not consider even 6 centimeters (2⅓ inches) as an absolute indication if the child is small and the head is mouldable.

After it has been decided to deliver through an abdominal incision, it must still be determined whether it is better to remove the uterus by the Porro operation, or, by performing the Sänger operation, to subject the patient to the risk of a possible subsequent pregnancy. In some cases the difficulty may be overcome by ligaturing the Fallopian tubes or removing the appendages before closing the abdominal wound. In doubtful or debatable cases individual circumstances must decide, but, in general, it may be said that the Porro operation is clearly indicated in preference to the Sänger—(1) if the uterus is infected, the chances of the mother's recovery being much increased by removal of the infected organ; (2) if there is partial or total obstruction of the parturient canal by tumors; (3) if there is carcinoma of the uterus, especially of the cervix; (4) in osteomalacia; (5) if complete inertia of the uterus occurs during the course of the operation.

Relative Indications.—The relative indications are difficult to formulate, and must generally be determined by the individual peculiarities of the case. A

degree of pelvic contraction or obstruction less than is requisite to constitute an absolute indication, but yet sufficient to make the safe delivery of a living and viable child by the natural passages doubtful, may be considered a relative indication. A conjugate of 6 to 8 centimeters (from $2\frac{1}{3}$ to $3\frac{1}{8}$ inches) and tumors of the pelvis or of the soft parts causing moderate obstruction are the commonest relative indications. The alternative operations are symphysiotomy, forceps, version, and craniotomy (see p. 68).

Time to Operate.—There is still a difference of opinion as to the best time to operate. Some operators wait until labor has fairly begun, in order to secure free drainage through the dilated cervix and to diminish the risks of hemorrhage; others operate four or five days before the expected date of labor. The latter method is preferable, because the patient can be prepared as carefully as for any other celiotomy, and the operation can be done deliberately, with all the advantages of a good light, trained assistants, etc. Those who wait for the onset of labor may have to operate hurriedly or at night, without proper preparation or skilled assistance; moreover, the membranes may rupture before the operation, which is always a disadvantage. Cesarean section is an elective operation whose success depends in great measure upon its being performed under the conditions most favorable to recovery; it seems, therefore, more prudent for the operator to determine for himself the time, place, and conditions of the operation than to trust to the uncertainties of accident or of chance.

The objections commonly urged against operating before labor are (1) that hemorrhage may take place on account of imperfect uterine contraction, and (2) that sepsis may occur from retention of the lochia, the undilated cervical canal not permitting free drainage. Experience shows that the first objection is unfounded, because the uterus does contract promptly and well after being incised and emptied. The second objection can easily be overcome by dilating the cervix from above and passing a drainage-tube or a strip of gauze into the vagina. That these objections are theoretical rather than practical seems to be proved by the results of the early operation in the United States, where in sixteen operations fourteen mothers and all the children were saved.

General Preparation.—If possible, the patient should be prepared as carefully as for any other celiotomy, special attention being paid to the state of the bladder and the bowels, disinfection of the vagina, and scrubbing and cleansing of the abdomen. The operation should be performed under an anesthetic. Some operators prefer chloroform to ether, as anesthesia is more rapidly produced and the child is less likely to be asphyxiated. Preparations should always be made beforehand for the resuscitation of the child, and delivery should be hastened as much as possible. The instruments required are scalpels, strong scissors, hemostatic forceps, needles and a needle-holder, sutures, a hypodermatic syringe with a supply of ergotin and ether, an irrigator, a piece of elastic cord or tubing, and occasionally a sharp curette and a thermo-cautery. There should be provided also a plentiful supply of aseptic towels, sponges, gauze, and boiled water, both hot and cold. The best needle

for the uterine suture is half-curved, round-bodied, and without a cutting edge. Three assistants are required—one to give the anesthetic, another to take charge of the fundus and the uterine incision, and a third to tighten the rubber band around the lower uterine segment. A fourth may be intrusted with the resuscitation of the child.

The Abdominal Incision.—Operators differ as to the best method of delivering the child. Some make a long abdominal incision and turn out the uterus before they open it and extract the child. Others make a much shorter incision, open the uterus, and extract the child before they turn the uterus out of the abdominal cavity. In the first method time is saved and fluids are easily prevented from entering the abdomen, but the disadvantages are serious. A very long incision is required—usually from a point 4 centimeters (1½ inches) above the symphysis pubis to one about 6 centimeters (2⅔ inches) above the umbilicus; an enormous cicatrix remains, which weakens the linea alba and leads sometimes to hernia, necessitating subsequent operation. In the second method the incision need seldom be more than 15 centimeters (6 inches) in length, extending from a point 4 centimeters (1½ inches) above the symphysis to a point 4 centimeters (1½ inches) below the umbilicus. This incision is usually sufficient for the introduction of the hand and the extraction of the child. Greater care is needed to keep fluids out of the abdomen, but the final results are better and the abdominal walls are less likely to be weakened. Whichever method is selected, a small incision should be made in the linea alba, and when the peritoneal cavity has been opened a finger is introduced as a guide and the incision is enlarged upward and downward by means of a strong pair of scissors. There will be less bleeding than if the whole incision is made with a knife.

When the long incision is employed, half a dozen long wire sutures are passed through the upper portion of the wound and left to be tightened afterward. The uterus is then pushed up into the incision and the abdominal walls are pressed back over it. As it emerges, the first assistant covers it with towels wrung out of hot water and supports it until a large flat sponge or a gauze pad, also wrung out of hot water, has been adjusted behind it, and the wire sutures are tightened. The rubber band is then passed around the lower uterine segment below the presenting part, and the ends are given to the second assistant. The anterior surface of the uterus is then incised in the middle line without reference to the situation of the placenta. It is unnecessary to spend time detaching the placenta and pushing it to one side when it is in the way, as recommended by some operators.

The uterine incision should be about 10 to 12½ centimeters (4 to 5 inches) in length. An opening is made, just above the lower uterine segment, large enough to admit one finger, and the incision is enlarged upward by means of a pair of scissors. The child is then seized by the extremity lying nearest the incision, whether it be the head, the breech, or the foot, and is extracted as quickly as possible. The cord is quickly tied and cut, the elastic ligature is tightened, the placenta and the membranes are carefully peeled off and removed,

and the uterine cavity is thoroughly irrigated with hot water or a hot antiseptic solution, such as corrosive sublimate (1 : 5000). Some operators dry the uterine cavity and dust it freely with iodoform just before closing the uterine wound; others continue irrigation with hot water while the sutures are being introduced and tied. After the uterine wound has been closed the elastic cord is relaxed and any oozing is checked with a hot sponge. The uterus, which has been kept well compressed by the first assistant, is cleansed and returned into the abdomen. The pelvic cavity is irrigated and sponged dry, the toilet of the peritoneum is made, and the abdominal wound is sutured as in an ordinary celiotomy. The usual antiseptic dressings are applied, and a hypodermatic injection of ergotin is given to prevent hemorrhage. The patient is put to bed, hot-water bottles are applied to the limbs, no food is given for twelve hours, and the bowels are moved within the first twenty-four hours. During the first week the nourishment should be liquid exclusively. The abdominal sutures can generally be removed from the tenth to the fourteenth day, and in favorable cases the patient may be able to sit up by the middle of the third week.

If the uterus is incised before being turned out, the technique is somewhat different. The abdominal incision is only about 15 centimeters (6 inches) long; the hand is passed into the abdominal cavity and swept around to ascertain the presence and situation of any adhesions. The elastic loop, held between the fore and middle fingers, is passed over the fundus and adjusted about the lower uterine segment; the ends are then given to the second assistant, who makes upward traction on them, thereby preventing hemorrhage and holding the uterus steadily against the pubes. While the uterine incision is being made the first assistant keeps the uterus firmly against the abdominal incision, and while the child is being extracted he promotes uterine contraction, makes steady pressure on the abdominal walls from above downward and forward, and gradually presses the uterus out through the abdominal incision. Wire sutures are not required in the upper part of the wound to keep the intestines from protruding. The subsequent steps of the operation are the same as in the method previously described.

Some operators make the operation comparatively bloodless by tightening the elastic ligature before the uterus is incised, and not relaxing it until the uterine wound is closed; others do not tighten it until after the delivery of the child. If the ligature is drawn too tight or is kept applied too long, there is danger of paralyzing the uterine muscle and producing subsequent inertia and hemorrhage. To overcome this difficulty Sänger proposes the use of an antiseptic towel folded to form a band. Other operators use no band at all, but direct the second assistant to grasp the lower uterine segment before the uterus is incised, and to compress it firmly with his hands until the child has been delivered and the wound has been sutured. Hemorrhage into the abdominal cavity sometimes occurs subsequently from uterine inertia or faulty suturing. If slight, it may be checked by an ice-bag over the uterus and a hypodermatic injection of ergotin; if abundant, the abdomen must be reopened, the clots turned out, and the bleeding point secured. Before the uterine wound is finally

closed some operators dilate the cervix from above and pack a strip of iodoform gauze 7.5 centimeters (3 inches) wide and 91.5 centimeters (3 feet) long into the uterine cavity, passing the end through the cervix into the vagina, to provide free drainage and to guard against intra-uterine hemorrhage by stimulating contraction. This practice is unnecessary in most cases unless the uterine muscle is flabby and weak and does not contract well.

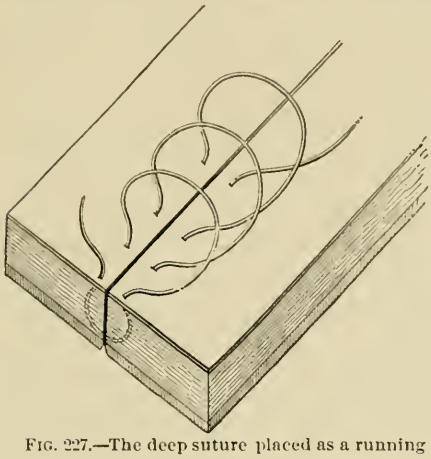


FIG. 227.—The deep suture placed as a running stitch; it includes peritoneal and muscular coats, but not decidual lining (modified from Grandin).

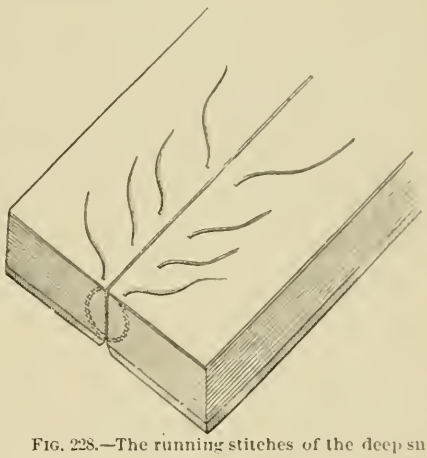


FIG. 228.—The running stitches of the deep suture cut to form interrupted sutures (modified from Grandin).

The Uterine Suture.—Silver wire, silk, and catgut sutures are employed, but, on the whole, silk or well-prepared catgut seems to be preferable. Most operators use two sets of interrupted sutures—a deep layer to approximate the divided muscular coats, and a superficial layer to close the peritoneum. The deep sutures of No. 2 silk pass from 3 to 6 millimeters ($\frac{1}{8}$ to $\frac{1}{4}$ inch) from the border of the incision diagonally down through the muscular tissue to, but do

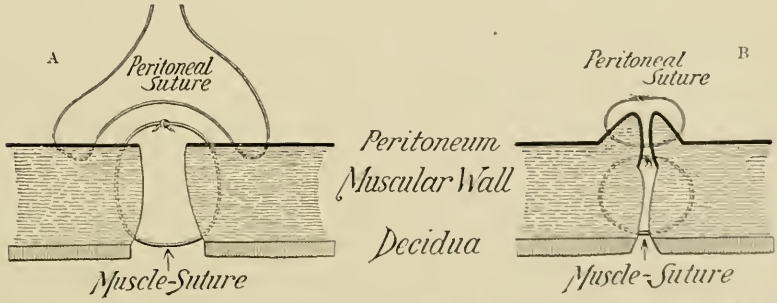


FIG. 229.—Diagrams of the peritoneal and muscle-sutures: A, before they are drawn tight and tied (modified from Fritsch); B, the two stitches after tying. The muscle-suture is buried and the upper suture folds the peritoneum together.

not include, the decidual lining (Figs. 227, 228). They are about $\frac{1}{2}$ inch apart, and are eight to twelve in number, according to the length of the wound. As soon as they are all introduced the uterine cavity is irrigated with a hot sublimate solution, the sutures are tied securely, and the ends are cut short. Then the superficial sutures of catgut or of No. 4 silk are put in to bring the

peritoneal borders into close apposition (Figs. 229, 230). The Lembert suture is generally employed for this purpose, though it is said that equally good results may be obtained by simply approximating the cut edges. One superficial suture is introduced over each deep one, and another midway between, making the number of superficial sutures double that of the deep ones. When they are all tied, the knots of the deep sutures are completely buried and the opposing surfaces of peritoneum are in close apposition (Fig. 229, B). The action and relations of these two layers of sutures are shown in Figure 229.

Dudley,[1] of New York, recently adopted a continuous catgut suture of three layers, which he states to be superior to the ordinary interrupted silk suture in two layers. The first row, which begins at the inner edge of the upper angle of the wound, includes the decidua and the inner muscular coats. It is continued to the lower angle of the wound, and when tightened it closes off the uterine cavity. Without cutting or tying the catgut, the second row is carried back to the upper angle, including the rest of the muscular tissue and sinuses, care being taken to pass the needle through the cut ends of any sinuses visible. When this row is tightened, about three-fourths of the depth of the uterine tissues has been closely approximated. Without cutting or tying the catgut, the third row, by an over-and-over stitch, completely buries the two lower layers and brings the peritoneal surfaces together; the catgut is finally tied at the lower angle of the incision. The advantages of this method are said to be—(1) that it brings the whole depth of the uterine wound into closer apposition, shortens the wound considerably, and prevents the danger of leakage between the sutures and the formation of blood-clots between the wound-edges; (2) that the suture is completely buried from beginning to end except where it catches the peritoneum; (3) that there is no rolling in of the cut surfaces and no eversion of the lips of the wound, and catgut is not more liable to be septic or to become septic than silk. It is urged against catgut that it is apt to stretch and to permit gaping of the wound, and that the knots are apt to untie; this may occur in the case of interrupted, but not with continuous, sutures; moreover, the abdominal surface of the uterine wound is covered with lymph in a few hours, and the peritoneal cavity is safe so far as the wound is concerned. In eight or nine days the catgut is absorbed and the wound is perfectly united; but when silk is used the suture becomes encysted, and some

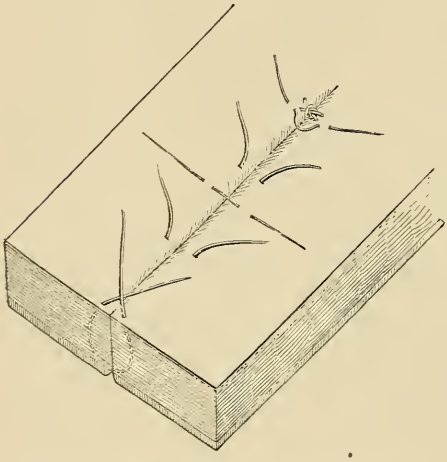


FIG. 230.—Two peritoneal sutures are here shown, one lying level, and the other as it is in process of tying; beneath the latter suture is seen the knot of the tied muscle-suture (Grandin).

[1] *American Journal of Obstetrics*, Jan. 1895, p. 16.

time elapses before it can be disintegrated and removed. Dudley says that with his method there is less likelihood of adhesion taking place between the uterus and the abdominal walls, and there is no danger of cutting down upon an encysted suture in a subsequent operation. He performs the whole operation, from the first incision in the abdominal wall to its final closure, under constant irrigation with hot water or with hot sublimate solution.

Cesarean Section immediately after the Death of the Mother or when She is Moribund.—When the mother's life is extinct there is no special technique, as the main point is to extract the fetus as quickly as possible. The operation is most likely to succeed if death has been sudden; if it has been slow or gradual, the child is usually asphyxiated beyond hope of restoration before the mother's life is extinct. If she is living, but *in extremis*, the operation must be done deliberately and with due regard to her safety, for one cannot be certain that she must inevitably succumb.

Porro Operation.—The procedure in this is precisely the same as in the Sänger operation until the uterus has been turned out of the abdominal cavity. Then the elastic ligature is passed around the lower uterine segment and is tied loosely, and a large piece of thin rubber sheeting, a thermo-cautery, and a Koeberlé écraseur are prepared for use. A small opening is made in the rubber sheet, to permit it to be passed over the fundus and carried down to the elastic band. The sheet serves to prevent fluids from the uterus entering the abdominal cavity. Then the elastic ligature is tightened, the uterus is incised, the child is delivered, the placenta is detached and removed, and the uterus and appendages are cut away just above the rubber sheeting. If the child has been extracted before the uterus is turned out of the abdomen, the ligature will have already been tightened, so that it remains only to slip the rubber sheet over the uterus as soon as it emerges through the abdominal incision, and amputate without delay. Many operators adopt Müller's method of applying the elastic ligature before incising the uterus. Fehling passes an additional ligature beneath the first as a precautionary measure. After the uterus is removed the stump is carefully disinfected and cauterized; it is treated either extraperitoneally, or the entire stump and cervix are removed and the abdominal wound is closed. The extraperitoneal method is more rapid, and is generally preferred if the patient is very weak or is suffering from shock. The loop of the écraseur is made to encircle the stump just beneath the rubber ligature, and is tightened until the tissues are blanched. Care must be taken not to enclose the bladder-wall in the loop of the écraseur. The rubber band is removed, the stump is trimmed and cauterized, and is transfixed above the wire loop with two strong steel pins passed transversely across the abdominal wound. The peritoneum is stitched around the stump with a continuous catgut suture, the abdominal cavity is cleansed and dried, and the abdominal incision is sutured. An iodoform dressing is applied, and left undisturbed for several days unless hemorrhage occurs or the temperature begins to rise. If the stump is moist, the dressings will soon become soaked with discharges; they must be removed and the stump thoroughly disinfected, any sloughy pieces being clipped off with scissors, and

fresh dressings applied. If there is any bleeding from the stump during the first three or four days, the bleeding point should be found and ligatured. The stump sloughs away in from ten to fifteen days, leaving a large granulating surface which is sometimes slow to heal. To hasten this process various expedients are employed. Sutugin scrapes and pares the surface of the stump to produce a raw surface, and closes the borders with ligatures, introducing a small tent of iodoform gauze into the lower angle of the wound for drainage. Others dilate the cervix and pass a strip of gauze from above through the cervix into the vagina. The intraperitoneal method is theoretically preferable, but so far its results are not ideal. The technique varies according to the circumstances of the case, but the main line of procedure is to free the bladder from its attachments to the lower uterine segment after the uterus has been removed and the stump has been disinfected, secure the broad ligament on each side with strong silk ligatures, tie the uterine arteries, divide the vaginal attachments of the cervix, and remove the stump. Any bleeding points are tied, the ends of the ligatures being left long, so that they may be passed down through the vaginal opening. Strips of iodoform gauze are firmly packed in the upper part of the vagina, and the peritoneal cavity is closed off by stitching the peritoneal covering of the bladder to the peritoneal layer of the cul-de-sac with a continuous catgut suture. The abdominal cavity is carefully cleansed and dried and the abdominal wound is sutured. The object of this method is to close the peritoneal cavity completely, turn the raw surface downward toward the vagina, and obviate the necessity of draining from above. Unless the operator is expert in abdominal work, it will be safer and easier for him to choose the extraperitoneal method. If the uterus has been infected, it is well to close the abdominal wound as much as possible before beginning to work with the pedicle, in order to avoid infecting the peritoneal cavity.

Laparo-elytrotomy.—This operation was devised by Thomas to avoid the risks of opening the abdomen and wounding the uterus; but since the perfecting of the Sänger and Porro operations has reduced these dangers to a minimum the necessity for laparo-elytrotomy can scarcely be said to exist. The method of procedure is to incise the abdominal walls in the line of Poupart's ligament, lift the peritoneum, dissect down to the vagina, and tear it through transversely, so that the cervix may be reached and the child be delivered through the passage thus made. This operation has been done thirteen times, seven of the mothers being saved.

Prognosis of Cesarean Section.—The mortality in pre-antiseptic days ranged from 30 to 50 per cent. It has been reduced to about 10 per cent. by doing the operation early, and not as a *dernier ressort*, and by practising a scrupulously aseptic technique. In private practice the prognosis for the mother depends very much upon the urgency of the case and the possibility of securing favorable conditions for the operation. It is far more difficult to carry out a proper technique in private than in hospital practice. The prognosis for the child is good; from 90 to 95 per cent. of the children have been saved. Since the mother should not run much more risk from Cesarean section than from

craniotomy, while the child is almost certainly saved in the one case and deliberately destroyed in the other, there can be very little question at the present day as to the choice of operation. In fact, craniotomy upon the living child is justifiable only under exceptional circumstances. It must be admitted, however, that the results of the Cesarean section in America have so far been disappointing, the mortality from the operation being much higher than in Europe. It should not be so, and we cannot expect that Cesarean section will replace craniotomy until our results have been considerably improved.

In the Porro operation the maternal mortality ranges higher, because of the more serious condition of the mother before operation. Notwithstanding the unfavorable circumstances usually present, the mortality has been reduced to about 25 per cent. In Italy the mortality is about 16 per cent., as the Porro operation is performed in cases where the Sänger operation would be preferred elsewhere. Breisky performed 11 operations, and Leopold 7, without a death.

Craniotomy and Embryotomy.—These are the terms applied to all destructive operations by which the volume of the fetus is reduced in order to permit delivery *per vias naturales.* Although in a literal sense all such operations might be included under Embryotomy, yet general usage has sanctioned a more restricted application of the term. *Craniotomy* is used to denote mutilation of the fetal *head; embryotomy,* mutilation of the fetal *trunk.* When a destructive operation has to be performed, the choice of method is determined by the nature of the presentation. Since the head presents in the great majority of cases, craniotomy is the commoner operation, while embryotomy is comparatively rare. Whatever may be the circumstances of the case, that operation should be chosen which is likely to expose the mother to the least risk.

The operative procedures included under the general terms craniotomy and embryotomy may be classified conveniently as follows:

1. Upon the *head:*
   (*a*) Perforation;
   (*b*) Cranioclasis;
   (*c*) Cephalotripsy;
   (*d*) Basiotripsy.
2. Upon the *neck:* Decapitation.
3. Upon the *trunk:* Evisceration or eventration.

Indications.—It is of primary importance to determine whether the fetus is living or dead. If dead, its bulk should be reduced whenever there is sufficient disproportion to make delivery difficult or dangerous. It is far better to mutilate a dead fetus in order that the mother may be delivered easily and safely than to subject her to the risks of a tedious and difficult forceps operation. Esthetic considerations and regard for appearances should not be allowed to weigh against the mother's safety. But when the child is alive the question becomes entirely different. Undoubtedly, in recent years symphysiotomy, Cesarean section, and the induction of premature labor have greatly narrowed the field of the destructive operations, but are we quite prepared to admit that craniotomy upon the living child is never justifiable? Pinard and his follow-

ers boldly take this ground, so do a few operators who have had exceptionally good results from Cesarean section; but most obstetricians feel that the results of the conservative operations do not yet warrant such a sweeping assertion. Until it has been established that the maternal mortality after the conservative operations is not greater than that after embryotomy, it would be rash to say that mutilation of the living child is never justifiable. In the minor forms of dystocia the choice of operation will probably lie between craniotomy and symphysiotomy or the induction of premature labor; in the major forms, between craniotomy and Cesarean section. The maternal mortality after basiotripsy in the Paris hospitals is practically *nil* when done in selected cases and under favorable circumstances. Leopold and others have had almost as good results from Cesarean section under similar conditions. But in private practice, when the skill and experience of the operator are not usually so great, when there is lack of skilled assistance and the surroundings are unfavorable, the results after either operation will be less favorable. When Cesarean section is performed as an elective operation, the mortality should not be greater than 10 per cent.; but when done as a *dernier ressort*, after ineffectual attempts to deliver by forceps or by version, the risk to the mother becomes very great indeed. Craniotomy in suitable cases, done deliberately and without force, should be little more dangerous than a forceps operation, but when done after repeated forcible attempts to deliver with forceps, especially if the disproportion between the fetus and the maternal passages is great, it becomes one of the gravest and most difficult obstetrical operations. Embryotomy on the living child involves such serious responsibility that it would rarely be chosen as an elective operation. Practically, therefore, elective embryotomy is seldom pitted against elective Cesarean section. When the operation is one of election, Cesarean section is generally the choice; when it is a *dernier ressort*, embryotomy is usually safer for the mother. The whole question turns upon an early and exact diagnosis upon the skill of the operator and upon the environment. If the patient has been examined carefully before the onset of labor to determine approximately the relative size of the fetus and the maternal passages, there should be very little difficulty in deciding upon the best course to pursue. But if labor has been allowed to drag along, and the disproportion has been diagnosed only after repeated failures to deliver by forceps or by version, the case assumes a different aspect, and the chances of safe delivery by any means are impaired. Such cases emphasize the necessity of making a careful examination of the pelvis in all pregnant women whose appearance or history suggests the possibility of deformity or disproportion. There is really no good reason why an amount of disproportion calling for Cesarean section or embryotomy should not be made out long before the onset of labor. But very often the physician does not see his patient until labor is well advanced, and then the case may call for prompt action, even though the surroundings are unfavorable and skilled assistance cannot be procured. Under such circumstances, if the disproportion is slight or moderate, a craniotomy could probably be done with far less risk to the mother than a symphysiotomy or a Cesarean

section; but if the disproportion is extreme, craniotomy becomes a very difficult and dangerous operation, and Cesarean section will give the mother a better chance even if the operator is inexpert. It is evident, therefore, that no positive rules can be laid down, for, even in the mother's interest, sometimes one operation may be preferable and sometimes another. At all events, it is premature as yet to say that mutilation of the living child is never justifiable. Under any circumstances the physician should not assume the full responsibility in such cases, but should leave the ultimate decision to the patient and her friends, after having laid the facts fairly before them.

The ordinary indications for embryotomy may be grouped as follows:

(1) Deformity of the pelvis, where forceps or version is either impossible or is dangerous for the mother.

(2) Disproportion between the parturient canal and the fetus that cannot safely be overcome by a conservative operation.

(3) Tumors—uterine, ovarian, malignant, or osseous.

(4) Monstrosities, such as hydrocephalus.

(5) Impaction of the presenting part, as in locked twins or in some face presentations, especially if there are swelling and inflammation of the vagina or of the cervix resulting from long impaction.

(6) Eclampsia and other causes which demand immediate delivery, if it cannot safely be accomplished in any other way. If the liquor amnii has long been drained away, the uterus sometimes becomes tetanically contracted about the fetus, and rupture is imminent; in such cases forceps, version, and Cesarean section are dangerous, and embryotomy affords the best chance for the mother. The child will probably have perished long before the question of embryotomy comes up for consideration.

Instruments.—Space does not permit a description of the numerous ingenious instruments which have been devised for the mutilation and extraction of the fetus. As the prime object of these operations is to reduce the bulk of the fetus, the first step is generally to perforate the presenting part and evacuate its contents, and then to apply a powerful instrument to compress it, so that it may safely be extracted through the narrowed passages. When the fetus cannot be so compressed, its bulk must be reduced by breaking it up and removing it piece by piece. Perforation is done by means of a perforator; compression is made by a cephalotribe, a cranioclast, or a basiotribe; comminution of the vault of the skull by a pair of small craniotomy forceps; decapitation by a blunt hook or an embryotome. So far as possible, embryotomy instruments should be made of metal and be so constructed that they can easily be rendered aseptic.

Perforators.—Three types of perforators are in use—the scissors, the trephine, and the heavy, spear-shaped perforator of the basiotribe. The scissors perforator may be straight or curved on the flat; on the whole, the straight form is the safer and answers the purpose very well. The original model of Smellie (Fig. 231) is still in use, but Simpson's (Fig. 232), Barnes's (Fig. 235), or Pinard's modification (Fig. 234) is preferable. Oldham's and Naegele's (Fig. 233) are more powerful instruments, but have no special advantages.

FIG. 231.—Perforator of Smellie.

FIG. 232.—Perforator of Simpson.

FIG. 233.—Perforator of Naegele.

FIG. 234.—Perforator of Pinard.

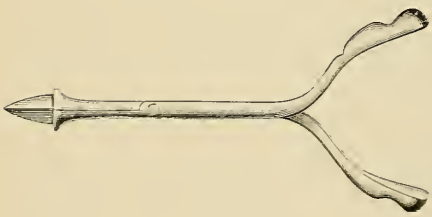


FIG. 235.—Perforator of Barnes.

FIG. 236.—Trephine of Braun (straight and curved).

Fig. 237.—Craniotomy forceps of Meigs.

Fig. 238.—Cranioclast of Barnes.

Fig. 239.—Cranioclast of Simpson.

Fig. 240.—Cephalotribe of Braun.

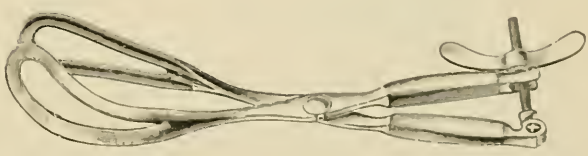


Fig. 241.—Cephalotribe of Lusk.

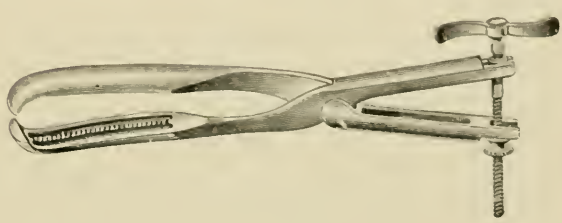


Fig. 242.—Cephalotribe of Hicks.

The Germans prefer the trephine, maintaining that the brain-substance can be broken up more easily, the skull being perforated through a bone, and not through a suture or a fontanelle. The models most commonly used are Braun's (Fig. 236) and Martin's, either straight or curved. They are harder to manipulate, and an assistant is required. The spear-shaped perforator of the basiotribe is not withdrawn like the other perforators, but is pushed through the brain-substance and imbedded in the base of the skull to steady the head while crushing is being done.

The cranioclast is a powerful prehensile craniotomy forceps, one blade of which is passed into the cranial cavity through the opening made by the perforator, while the other grasps the head outside. When the blades are forcibly pressed together by means of a strong compressing screw at the end of the handle, a firm grip of the head is obtained, and extraction is easy unless the passages are very small. The small blade which is passed into the skull is solid and is grooved on its convex surface, with the tenon of the lock on the

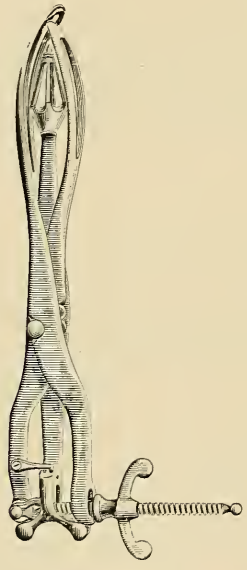


FIG. 243.—Tarnier's basiotribe.

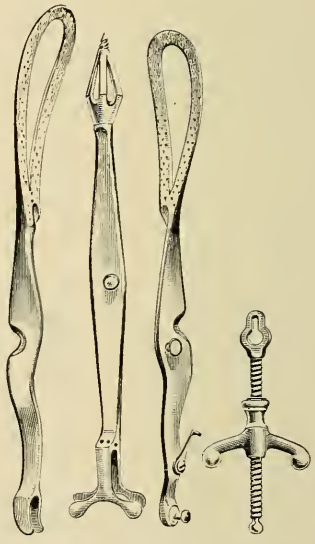


FIG. 244.—Tarnier's basiotribe (separate parts).

handle; the larger blade, which grasps the outside, is fenestrated and is grooved on its inner concave aspect. A moderate pelvic curve is generally given to the instrument to facilitate introduction and extraction. The favorite models are those of Barnes, Simpson, and Braun (Figs. 238, 239). The cranioclast is essentially a tractor, and is sufficient in most cases of craniotomy, unless it is found necessary to crush the base of the skull. The advantages claimed for it are—(1) that it is not apt to tear away when scalp and bone are seized together; (2) that it seldom slips when once a firm hold is obtained; (3) that the head can be seized in any diameter without fear of slipping; and (4) that when the parietal bones have been removed the base of the skull can be so

seized as to bring it through a pelvis with a conjugate of only 4½ centimeters (1¾ inches) and a transverse of 7½ centimeters (3 inches) (Barnes).

Cephalotribe.—This instrument was invented by Baudelocque to supersede the perforator. It is essentially a powerful compressing forceps (Figs. 240–242), made to crush the head before extracting it. The blades are applied outside the head, like those of the ordinary forceps; the instrument therefore differs essentially from the cranioclast, which has one blade inside and the other outside the skull, and is not essentially a crusher, but is simply an extractor. The cephalotribe is more bulky, takes up more room in the pelvis, does not

FIG. 245.—Tarnier's basiotribe in action; the perforator being in place, as is also the first blade.

FIG. 246.—The first blade of the basiotribe has crushed the occiput, and the second blade is applied.

FIG. 247.—The second blade of the basiotribe has crushed the sinciput.

grasp the head so securely, and is more likely to slip than the cranioclast. The cephalotribe is therefore less useful in ordinary cases, and is nowadays very little used. The Hicks model (Fig. 242) is preferred in England, while Lusk's instrument (Fig. 241) is the favorite in America.

Basiotribe.—Tarnier's basiotribe is the most perfect instrument for craniotomy yet invented, being at once a perforator, a cranioclast, and a cephalotribe, and is capable of being used in pelves measuring no more than from 4 to 6 centimeters (1½ to 2⅜ inches) in the conjugate diameter. The cranioclast seizes well, but crushes poorly; the cephalotribe crushes well, but seizes poorly; the basiotribe combines the good points of both, for it both seizes and crushes well. The basiotribe is composed of a perforator, two blades of unequal length, and a powerful compressing screw (Fig. 243). The central piece, or perforator, consists of a straight bar of metal, terminating at one end in a

fenestrated, spear-pointed tip, and at the other end in a small cross-bar, through which the compression-screw works (Fig. 244). About halfway down the handle is a tenon upon which the shorter blade articulates. The shorter blade carries a tenon upon which the longer blade articulates, and a small hook to fasten it to the perforator after the first crushing has been done. At the end of the handle is a pivot to which the compressing screw is attached. The longer blade, about 42.5 centimeters (17 inches) in length, articulates with the shorter blade, and has a groove at the end of the handle to receive the compressing screw. When closed the instrument measures from side to side 4 centimeters ($1\frac{1}{2}$ inches), from before backward $4\frac{1}{2}$ centimeters ($1\frac{3}{4}$ inches), and weighs a little less than 1000 grams ($2\frac{1}{2}$ pounds). Bar and Tarnier have recently modified the original instrument so that it can more easily be used in face presentations. The blades of this modified instrument are made a little longer and of equal length, and are so arranged that either the right or the left blade can be introduced at will after the perforator.

Hook and Crotchet.—This instrument consists of a slightly curved metal bar terminating at one end in a blunt hook and at the other end in a sharp crotchet-tip (Fig. 248). The hook is used to pull down the neck; the crotchet is sometimes caught into the orbit or the foramen magnum, after perforation, and employed as an extractor, or it may be used to break up the brain after perforation. The blunt hook may occasionally be serviceable in extracting the after-coming head following perforation. It is passed through the opening made by the perforator, and is hooked over the base of the skull. Sometimes it may be employed with advantage in the delivery of the trunk in difficult cases, if hooked under the posterior shoulder. The hook and crotchet is less used than formerly, but is nevertheless very helpful if better instruments are not at hand. It should be handled with care, for it is very apt to slip and injure the maternal soft parts.

FIG. 248.—Hook and crotchet.

Small Craniotomy-forceps.—It becomes necessary sometimes to break down the cranial vault after perforation and to remove the bones piecemeal. For this purpose a modified bone-forceps is used. The best model is Taylor's modification of Meigs's instrument (Fig. 237).

Decapitating Hook.—In neglected transverse presentations decapitation is sometimes the readiest and safest means of effecting delivery. Braun's hook is extensively used for this purpose in Germany. This instrument consists of a steel rod fitted with a strong handle at one end and a short hook tipped with a rounded button at the other. The hook forms an acute angle with the shaft of the instrument, the distance between the button and shaft being 2 centime-

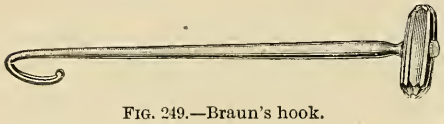


FIG. 249.—Braun's hook.

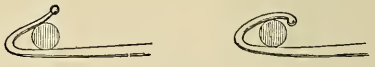


FIG. 250.—Detail of hooks, old and improved forms.

ters ($\frac{3}{4}$ inch, Fig. 250). Zweifel of Leipsic recently modified this instrument, as shown in Figure 249, and has introduced a new instrument which he believes to be safer (Fig. 251).

Embryotomes.—Several ingenious but complicated instruments have been invented for use in desperate cases. They are expensive, easily get out of order, are seldom available when wanted, are difficult to apply, and are apt to injure the maternal soft parts. However useful they may sometimes prove in large hospitals, they are practically out of the reach of general practitioners. The best is Tarnier's embryotome, which combines the blunt hook with a cutting instrument so guarded that nothing but the part grasped by the hook can be cut when the knife-blade is released from the guard.

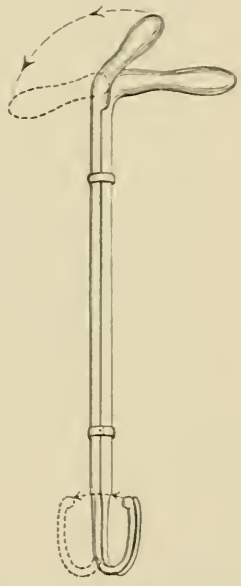


Fig. 251.—Zweifel's trachelorhector.

Operation.—In no other obstetric operation is strict attention to antisepsis more important than in craniotomy, since the maternal soft parts are so liable to be wounded by the instruments or by spicules of bone from the mutilated head, and most of the subsequent ill effects are directly traceable to septic infection.

Craniotomy of the Presenting Head.—After the bladder has been emptied and the vulva and vagina disinfected, the patient should be placed on a table in the dorsal position as for the forceps operation, an anesthetic administered, and the head steadied in the pelvis by pressure from above. Full dilatation of the cervix is advisable, but is not essential. Two fingers of the left hand are passed up through the cervix to the presenting part, and held firmly against it as a guide. Throughout the operation these fingers should guide the instruments and guard the maternal soft parts from injury. The perforator, held in the right hand, is passed along the guide-fingers to a suture or a fontanelle if possible. The point should be kept at right angles to the presenting part, to prevent slipping, and the part selected for perforation should be nearer the symphysis than the promontory (Fig. 252). Then, with steady pressure or a careful boring movement, the point is made to enter the cranial cavity, and the perforator is pushed home as far as the shoulder-guard will permit. The opening is enlarged by compressing the handles so as to separate the blades. The instrument is then closed and withdrawn slightly to permit its being introduced again at right angles to the first incision. The blades are again separated, then finally closed and withdrawn. By this means a crucial incision is made, through which a

metal nozzle or crotchet can be introduced to break up the brain-substance. The remaining steps of the operation will be more cleanly if a syringe is attached to the nozzle and the broken-down brain-matter is washed out with sterilized water. When the fetal skull is completely emptied of brain-matter, it can more easily be compressed and extracted than if it is only slightly or partially emptied. If a suture or a fontanelle cannot easily be reached, a good perforator with a sharp point can readily be pushed through the substance of any cranial bone. In face presentations the perforator should be passed through the orbit or one of the frontal bones if possible, or, failing in that, through the roof of the mouth, behind the nasal fossæ. When the bony landmarks are

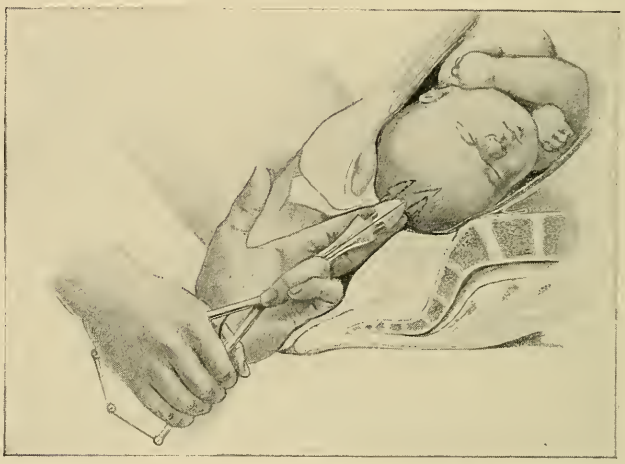


FIG. 252.—Perforation of the head begun: the right hand is grasping the handles of the instrument. The tips should not be separated until after they have entered the fontanelle.

unrecognizable, perforation may be made wherever most convenient, but then the instrument should be carried very deep.

Craniotomy of the After-coming Head.—This is always a difficult operation, since the trunk interferes with the necessary manipulations. Moreover, the trephine can rarely be used, the scissors perforator is apt to slip, the thin cranial vault is out of reach, and only the thicker, denser portions of the skull are accessible. It is usually recommended to perforate through a lateral fontanelle or at the articulation of the occiput and atlas. The body of the fetus may require to be drawn upward or downward, to the right or to the left, to bring the desired point within reach of the guide-fingers. Practically, the operator must generally be content to perforate at any point behind the ear that he can reach, without troubling to find a fontanelle or a suture. If the occiput is behind the pubes, the operator passes three or four fingers under the symphysis to the occipito-atlantal articulation, while assistants steady the head in the pelvis and draw the body downward and backward. The perforator, guarded by the fingers, is inserted between the occiput and the atlas, and a crucial incision is made. After the brain-substance has been broken up and washed away the head can usually be delivered without difficulty; occasionally,

however, the cranioclast is required. When perforation of the occiput under the symphysis is difficult or dangerous, the body may be drawn upward and the perforator introduced through the mouth or the orbit. If the occiput is posterior, the body is raised until the perforator can be pushed into the occiput posteriorly. If the head lies transversely in the pelvis and cannot be rotated into the antero-posterior diameter, the body may be drawn upward or downward and the side of the head be perforated near the ear. Strassmann of Berlin recently proposed perforating between the chin and the neck (Fig. 253),

FIG. 253.—Craniotomy on the after-coming head: one method of perforating.

passing the instrument through the base of the tongue until its point is felt by the fingers in the mouth, then pushing it through the posterior nares into the foramen magnum, when the blades are separated and the base is broken up. A nozzle is passed through the opening, and the cranial contents are broken up and removed.

After perforation and excerebration some operators allow labor to terminate by the natural efforts, while others deliver by means of forceps, cranioclast, cephalotribe, or version. In most cases there is nothing to be gained by waiting, and it is generally safer and better to deliver without any unnecessary delay.

With the strong French forceps, which is a powerful compressor, it is sometimes possible to deliver the perforated head; but the ordinary forceps is too feeble an instrument, and is apt to slip unless the disproportion is very slight. When no other extractor is available, forceps delivery can be made less difficult by washing away the brain-substance completely and removing portions of the cranial bones with short craniotomy forceps. Care should always be taken to protect the passages from injury by sharp spicules of bone during extraction. The forceps proves more useful in the delivery of the perforated after-coming head; there is then far less risk of slipping or of wounding the soft parts.

Notwithstanding the warm commendations of Tarnier, Taylor, and others, version after craniotomy must be regarded as a dangerous operation in most

cases. When labor is protracted the uterus tends to retract about the body of the child and the lower uterine segment becomes distended. Attempts to turn under such circumstances, especially if any spicules of bone protrude from the opening in the skull, must expose the mother to serious risks.

Cranioclasis.—The cranioclast is a tractor, not a comminutor, and the operation of cranioclasis consists in getting a firm hold of the mutilated head with the cranioclast and delivering it through the narrowed passages, not in crushing or breaking up the cranial bones. The solid blade, held in the right hand, is guided through the opening made by the perforator and is pushed well down to the base of the skull. The fenestrated blade is then applied to the outside of the skull, directly opposite the blade which is inside; the blades are locked, and the compression-screw is tightened until the head is firmly grasped between them. The blades will be less likely to slip if the outer one is applied to the face rather than to the occiput. Before locking, the handles should not be held horizontally, but should be depressed, so as to make sure of including the chin in the bite. Before beginning to extract, the cranioclast should be so turned as to bring the longest diameter of the head into the transverse diameter of the pelvis. During extraction the left hand should be kept in the vagina to guard the perforation and to protect the maternal soft parts from being injured by projecting edges of bone. The line of traction should be in the axis of the pelvis, the same as in the forceps operation. If any pieces of bone protrude, they should carefully be removed before traction is continued. In difficult cases it may be necessary to strip back the scalp and remove the parietal bones by means of small craniotomy forceps; the blades of the cranioclast can then be so adjusted as to get a good grasp of the frontal bones and the face, and extraction will be easy. Occasionally it will be found easier to introduce the fenestrated blade first and to adjust it carefully before passing the solid blade into the cranial cavity. In most cases the body comes through easily after the head has been extracted. If the body is so large that it cannot be delivered with a moderate amount of traction, it should be perforated between the clavicle and the scapula, and the cranioclast so adjusted that the fenestrated blade is applied over the back. The cases are extremely rare in which delivery cannot be accomplished by perforation and cranioclasis.

Cephalotripsy.—Occasionally the fetal head is too large or too much ossified to be delivered safely with the cranioclast, and it becomes necessary to crush it in order to reduce its bulk. *Cephalotripsy* is the name given to this crushing and extraction of the fetal head. When the operation was first proposed, it was hoped that it would supersede perforation; but this hope has not been realized, and at the present day, when the head is presenting, it is almost invariably perforated before being crushed. The cephalotribe in general use is a powerful forceps with slight cephalic curve, fitted with a strong compression-screw at the end of the handles. The blades are introduced like those of the forceps, and when the head has been fairly grasped the compression-screw is slowly tightened. The opening made by the perforator should be watched carefully for pieces of extruding bone while compression is being made,

and the maternal passages should be protected during extraction. When the cephalotribe gets a good grasp of the head, it crushes satisfactorily; but the difficulty is to get and keep a good hold, for the head is apt to slip away when the compression-screw is tightened. As Pinard remarks, it is one thing to seize the head with the blades of the cephalotribe, but quite another to hold it while being crushed. Cephalotripsy is indicated when the pelvic contraction is only moderate or slight; but when the contraction is extreme the instrument takes up too much room and the tractile force required to effect delivery is dangerous for the mother. When the conjugate of the brim measures less than 7 centimeters ($2\frac{3}{4}$ inches), the operation becomes difficult; when less than 6.3 centimeters ($2\frac{1}{2}$ inches), it is highly dangerous.

In difficult breech cases, when the after-coming head cannot be delivered by manipulation or by forceps on account of slight pelvic contraction, its bulk may be reduced sufficiently by cephalotripsy even without perforation. Or if perforation has been done and the forceps does not hold, or if it is found necessary to reduce the bulk by crushing the base of the skull, the cephalotribe will be useful. Or if the body has been delivered and the head, which is free in the uterine cavity, cannot be seized and delivered with forceps, it is sometimes necessary to steady the head in the pelvis, fix it by means of a crotchet passed into the cranial cavity, and then apply the cephalotribe to crush the skull before it can be extracted. In all such cases the maternal tissues should be carefully guarded against injury.

At the present day cephalotripsy is seldom done; when craniotomy is indicated and the pelvic contraction is only moderate or slight, perforation and cranioclasis usually suffice; when the pelvic contraction is extreme, basiotripsy or Cesarean section is preferable.

Basiotripsy.—Basiotripsy is an improved cephalotripsy which in France has completely taken the place of the latter operation whenever pelvic contraction is moderate or extreme. The steps of the operation are perforation, the small crushing, the great crushing, and, finally, extraction. The perforator, held in the right hand, is guided along the fingers of the left hand to the point selected for perforation; kept at right angles to the skull, it is thrust through the cranial bone and pushed along until its point is imbedded in the base. The short blade, which corresponds to the left or lower blade of the forceps, is introduced like the forceps-blade, and is articulated with the tenon on the handle of the perforator. Then the compression-screw is adjusted and tightened until the short blade is forced close to the perforator; the hook is closed down, which securely fastens the short blade to the perforator. This procedure is the small crushing. The compression-screw is removed, and the long blade is applied like the right or upper blade of the forceps and articulated with the tenon on the handle of the short blade. The compression-screw is again applied, and slowly tightened until the long blade is brought close to the perforator. This operation is the great crushing. If the instrument has been properly applied, the vault and base of the skull will have been crushed and flattened by the operation to a little less than 2 inches, and extraction will

be comparatively easy. Tarnier and his followers set 4 centimeters (1⅝ inches) of the conjugate as the lowest limit for basiotripsy. Below this limit the mother is exposed to risks as great as from Cesarean section, but above 6 centimeters (2⅜ inches) the maternal mortality is practically *nil*. Pinard operated fifteen times consecutively without a death, the conjugate in one case measuring only 6 centimeters (2⅜ inches). This operation was done forty-nine times without a death in the practice of Pinard and his colleagues, and in all the cases the puerperium was normal.

Decapitation and Evisceration.—These operations are indicated (1) in neglected transverse presentations with impaction, where version is dangerous or impossible and the head cannot be brought down far enough for craniotomy; (2) when a monster or some pathological enlargement of the fetal structures renders delivery otherwise impossible. Decapitation is indicated when the neck of the fetus is within reach and a hook can be passed over it; evisceration is indicated in all other cases. These operations are always difficult and dangerous. The impaction of the fetus interferes with manipulation, while the uterine tissues are thinned and apt to be injured or be ruptured by the hands or instruments.

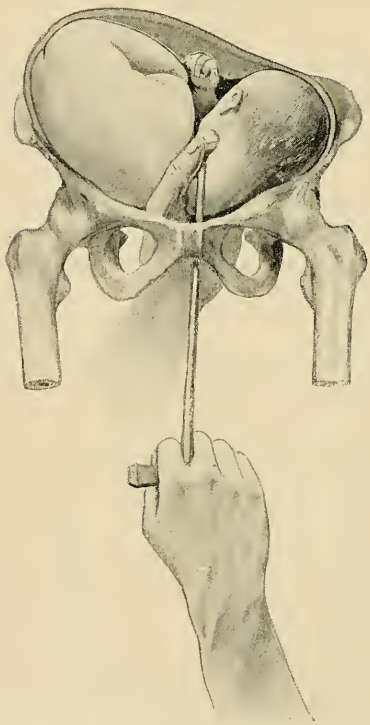


FIG. 254.—Decapitation with Braun's hook.

For *decapitation* Braun's hook (Fig. 249) is the simplest and most efficient instrument; it is less likely to injure the mother than the more complicated contrivances. Before operating the bladder should be emptied and the parts thoroughly disinfected. An arm is brought down and a tape is attached to it, so that an assistant may make traction when required. Then the whole hand is passed into the vagina, palm upward, with the thumb close to the symphysis and four fingers in the hollow of the sacrum, until the neck is clasped between the thumb and the middle finger. If the head is lying toward the mother's left side, the right hand is introduced into the vagina; if the head points to the mother's right side, the left hand is introduced. The hook, with its concavity pointing away from the head toward the body, is grasped in the other hand, palm downward, is passed along the thumb of the inside hand, and is guided over the child's neck until the tip touches the operator's middle finger. During the passage of the hook it should lie all the time beneath the thumb and the fingers, which should not be separated. The neck is put on the

stretch by pulling the handle of the hook firmly downward (Fig. 254) while an assistant draws down the arm by means of the tape. While strong traction is being made the handle is quickly raised as far as possible, and twisted forcibly *from breech toward head*, so that the button of the hook comes against the head. Three or four twists (Figs. 255, 256) are generally sufficient to sever the head from the body. Throughout the operation the inside hand must protect the maternal tissues from injury. Twisting should never be done unless the hook is clasped between the thumb and the finger of the guiding hand. As soon as the neck is divided the head recedes, and the body is easily delivered by pulling upon the prolapsed arm; the head is subsequently extracted with for-

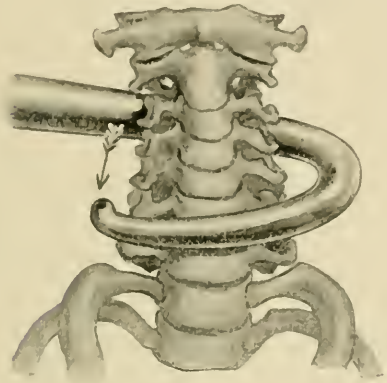


FIG. 255.—Braun's hook seizing the cervical vertebræ and rotated.

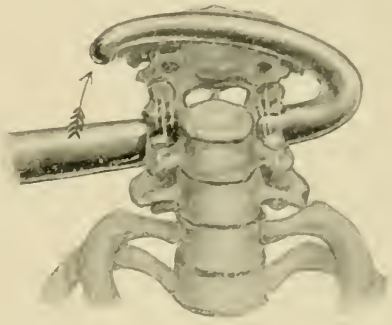


FIG. 256.—Braun's hook rotated in the opposite direction; the spinal column giving way.

ceps or the cephalotribe. During the extraction of trunk and head the maternal passages should be guarded against injury from the ragged ends of the severed vertebræ. If Braun's hook is not available, a strong cord may be carried around the neck by means of a gum-elastic catheter, and the soft parts be sawn through by pulling upon the ends of the cord; or a long, blunt-pointed scissors may be used to snip through the tissues, always taking care to guard the points. There has been considerable controversy as to the merits of Zweifel's trachelorhector; upon the whole, the opinion seems to be that the new operation is no improvement upon the old.

Evisceration may be accomplished by opening either the thorax or the abdomen with blunt-pointed scissors, and breaking up the internal organs and removing them by means of a volsella; or the scissors-perforator may be carried up to the most accessible portion of the trunk, and an opening be made through which a crotchet or a metal nozzle can be introduced to break up the internal organs. The operation is very tedious, and great care must be taken not to injure the uterus or the passages. After any pieces of loose bone have been removed the blunt hook may be introduced, and an attempt may be made to extract the trunk by pulling it down and bending it upon itself. If this maneuvre fails, nothing remains but to dismember the fetus and deliver it piece by piece. Chain-saws and embryotomes of more or less complicated

pattern have been devised for use in difficult cases ; but they are seldom available when wanted, are difficult to apply, and are apt seriously to injure the maternal passages. Symphysiotomy has been advised in these difficult cases, to give more room for manipulation and extraction. Pinard, however, protests strongly against the use of symphysiotomy for the delivery of a dead or mutilated fetus, maintaining that thereby the mother's chances of recovery are much impaired. Cases are occasionally met with where the ordinary methods of decapitation and evisceration are not feasible. Spencer,[1] of University College, London, drew attention to two such classes of cases: (1) When it is impossible to deliver the body after the head has been extracted, on account of unusual size of the body or of pathological conditions in the serous cavities or the viscera ; (2) when the back of the fetus presents, rendering decapitation impossible. In the first class, when traction fails to deliver, he suggests snipping through the clavicles (cleidotomy) and introducing a blunt hook into the axilla to bring down the arms, or decapitating and then passing the hand over the thorax and opening the abdomen. Care must be taken to seize the neck with a volsella before decapitating, to prevent the trunk from receding out of reach after the head is removed. In the second class he suggests snipping through the spinal column with a pair of scissors, seizing the trunk with a cranioclast, and drawing it down so that it can be snipped through. The two halves of the body then can be delivered readily.

After-treatment.—After the mutilated fetus has been delivered and the placenta has come away, a hot antiseptic uterine douche should be given, and the parturient canal examined for traumatisms, which should be repaired immediately. During the puerperium the chief danger is sepsis, and the treatment should be regulated accordingly.

Prognosis.—The prognosis of embryotomy depends in great measure upon the degree of disproportion present, the condition of the patient, the stage of labor, the nature of previous attempts to deliver, the amount of injury done to the maternal tissues, and, above all, upon the presence or absence of sepsis. When the disproportion is not extreme, and the operation is done early, before the patient has become exhausted by a protracted labor or by futile attempts to deliver, when the maternal soft parts have not been bruised and lacerated, and when all the manipulations have been done with strict antiseptic precautions, the mortality should be very low. Craniotomy may be a very easy or a very difficult operation, according to the degree of disproportion and the stage of labor at which it is done. Other things being equal, embryotomy is more dangerous than craniotomy. In private practice there are many difficulties and disadvantages to overcome, which are not encountered in well-arranged maternities ; consequently the mortality may be reasonably expected to be higher ; but, unfortunately, it is far higher than it ought to be, owing in great measure to the want of early and exact diagnosis, and to the prevailing tendency on the part of the general practitioner to postpone operation until forceps and version have been tried repeatedly and have failed. The brilliant results of basio-

[1] *British Medical Journal*, April 13, 1895, p. 808.

tripsy show the possibilities of the operation when done early in suitable cases. There can be very little doubt that early operation and strict antisepsis would minimize the chief immediate dangers, rupture and sepsis, as well as the risks of subsequent pressure-complications, such as fistulæ. But we can scarcely look for much improvement in our results until the profession as a whole comes to have clearer ideas respecting the limitations as well as the indications of the destructive operations, and is more generally possessed of a sensitive "antiseptic conscience."

II. Manual Operations.

Varieties and Methods of Version.

Version is a manual operation, designed to bring about a partial or a complete change in the relation of the long axis of the child to the long axis of the mother, whereby a longitudinal is substituted for a transverse presentation, or one end of the child is substituted for the other. The *object* attained is the exchange of a less favorable presentation which nature cannot deliver, such as a shoulder, for a presentation that is favorable for expulsion, such as a head, a breech, or a footling; or, in such an emergency as placenta prævia or a contracted pelvis, a change of the presenting part from head to foot in order to secure speed or ease in delivery.

Omitting the study of the infrequent cases in which nature can compass version, and which have been considered under the head of *Mechanism of Labor* (p. 539, Vol. I.), we find three *varieties* of version: (A) cephalic, (B) pelvic, and (C) podalic, and three *methods* of version: (1) external, (2) bipolar, and (3) internal.

Varieties.—Cephalic version causes the head to present; pelvic version, the breech; and podalic version, one or both feet.

Choice of Variety.—For cephalic version an easy case, an ample pelvis, and labor not under way are the ordinary conditions; pelvic version is an occasional early preparation for labor with placenta prævia; while podalic version is our chief reliance in urgent or difficult cases.

Methods.—External version is accomplished by manipulation through the abdominal wall. Bipolar version is effected by passing two fingers through the cervix and tossing along the successively presenting parts of the child until the leg can be seized, while the external hand does its part through the abdominal wall. For internal version one hand is pushed freely into the uterine cavity to grasp the foot or the knee, on which traction is made while the other hand assists from without.

Choice of Method.—In a typical case we should attempt the correction of the presentation by the three methods in the order named. The indications for each method will be given in its proper section, but they may be summarized here:

1. *The external method* is not often employed, because its success depends on a combination of conditions that is seldom found. It is the simplest and

safest procedure, and will be more often required as early recognition of the position of the child by abdominal palpation becomes more common. It demands the presence of the liquor amnii, or at least a relaxed uterus and abdominal wall, with free mobility of the child, and is usually available only before labor or early in its course.

2. *The bipolar method* has the advantage over the internal method in that "it can be performed at the commencement of labor, long before the os is completely dilated, and that it obviates the necessity of introducing the whole hand into the uterus, which is not without danger to the parturient and the child." But it is not always easy or feasible.

3. *The internal method* is the obstetrician's chief reliance, especially in urgent or difficult cases, but it is many times an operation of no little moment.

Indications for the Operation: A. *Indications for Cephalic Version.*—Breech presentation calls for cephalic version when all conditions are favorable—such as a sufficiently roomy pelvis—and when it can readily be accomplished by the external method before labor by a practised hand. Under such circumstances shoulder cases will also be amenable to this variety of turning.

B. *Indications for Pelvic Version.*—As this maneuvre is rarely employed, its consideration may be brief. It is only undertaken by the method of external version, as by other methods we bring down one or both feet. It is indicated for placenta prævia and for a slightly-contracted pelvis before labor or early in labor.

C. *Indications for Podalic Version.*—Stated in the order of their importance, the conditions under which version should be chosen are:

1. In transverse presentations, which are chiefly shoulder cases. This indication is the most frequent, and includes all except small or macerated fetuses, and the few instances in which cephalic version is preferred.

2. In normal pelves and head presentations, when the life of the child or that of the mother is threatened, if the head cannot be induced to engage and the cervix is not dilated so that forceps can be applied. This indication includes placenta prævia, except in the simpler marginal variety with the head low in the pelvis, and scant bleeding. It also covers cases of prolapse of the cord not otherwise manageable. In certain instances with prolapse of one or more extremities, and chiefly when the foot presents, podalic version is our resource, as also in the most troublesome face or brow presentations with the head at the inlet, when the posture of the head cannot be rectified manually, and particularly in posterior positions. Lastly, in certain other emergencies, should the case call for rapid extraction, we employ version, as in eclampsia and in accidental hemorrhage.

3. In contracted pelves. Version is called for in flat pelves where the true conjugate is not below 8 centimeters ($3\frac{1}{2}$ inches), where there is a relative disproportion between passage and passenger equivalent to the above-named contraction, where the head does not engage and changes its position frequently above the brim, or where previous breech deliveries have been more favor-

able than vertex presentations, and also "in obliquely-contracted pelves and unsuccessful or unfavorable engagement of the head with the occiput over the contracted side."

Contra-indications to Version.—Rigid and permanent contraction of the wall of the uterus, especially in dry labors; high position of the retraction-ring (5 to 7.5 centimeters—2 to 3 inches—above the symphysis—Winckel); engagement of the head; impaction of the presenting part which would require dangerous pressure to dislodge,—all contra-indicate version.

Dangers of Version.—Rupture of the uterus, shock, increased risk of sepsis, hemorrhage, and laceration are the hazards for the mother. In external and bipolar version these dangers are usually insignificant, because we rarely use much force in these procedures, but in internal version there is risk of uterine rupture. It is for this class of cases that we urge the necessity of firm gentleness and the avoidance of operation in the presence of pronounced tension or thinning of the uterine wall. There is, of course, no obstetric operation more likely than version to infect the mother if the operator does not carry out aseptic measures, except, perhaps, that of Cesarean section. The danger of laceration and of shock is proportionate to the rapidity with which the child is turned and extracted, and to the lack of skill of the operator. To the child the dangers are fracture of the femur or the humerus, together with the usual risks of breech labors.

Cephalic Version.—"As head presentation is the type of natural labor, it follows," says Barnes, "that to obtain a head presentation is the great end to be contemplated by art, but practically head-turning is little known. Delivery by the feet is almost universally practised when the substitution of a favorable for an unfavorable presentation has to be accomplished. Why is this? The answer rests chiefly upon the undoubted fact that in the great majority of instances, at the time when the mal-presentation comes before us, turning by the feet is the only mode of turning which is practicable." It may also be noted that lack of certainty concerning presentation and position, due to defective training in abdominal palpation, leaves the patient without help until the time has passed for the milder manipulation.

Conditions for Cephalic Version.—For a favorable outcome by this method, labor should not yet be under way, or should not be so far advanced that there is any marked tension of the uterine walls. The liquor amnii should be present, and the abdominal walls neither tense, tender, nor thickly padded with fat. Among transverse conditions we prefer an obliquity that is moderate, with the shoulder not yet driven down into the pelvis. To convert a breech into a vertex presentation, not only must these favoring circumstances be present, but the operator should also be endowed with skill in version and experience in abdominal palpation, so that his maneuvre shall not be arrested halfway and a breech case be converted into a transverse presentation.

The *advantages* of cephalic version are evident, and in the presence of a sufficiently capacious pelvis should induce skilled operators to undertake this

measure. The *disadvantages* consist in the limited scope of the procedure and the experience required.

Steps of the Operation.—Cephalic version is practically confined to the external and bipolar methods, and the steps are the same as in these methods, which are described on another page, except that the fetus is to be moved in the opposite direction from that described under podalic version. If the operator prefers to do version with the woman lying on her side, she should be on the same side as that on which the head is found. Supposing the case to be one in which the head is in the left iliac fossa, and the fundus, with the breech, is to the right of the mother's spinal column, the woman is to be placed on her left side. In this posture the fundus of the uterus, loaded with the breech and being movable, will tend to fall toward the dependent side.

1. **External Version.**—This method, the simplest and safest of the three methods of turning, will become more commonly employed as the general practitioner adopts the habit of a thorough examination by abdominal palpation a month before labor for each pregnant woman under his care. Whenever possible, it should be attempted before the other methods are begun. As Fritsch well says: "Even to-day, when the danger from sepsis is small, a successful external version means the achievement of large results through little means."

Indications for External Version.—The indications, in general, are the same as those that apply to all versions, the special *conditions* required being the presence of the liquor amnii or its recent loss, leaving a relaxed and insensitive uterus with free mobility of the child. External version should be undertaken only when it can be performed without violence; this period, as a rule, is before labor is actually established, or at any rate before rupture of the membranes. It may be performed with advantage for a high transverse position of the second child in twin labors.

Contra-indications.—External version cannot be effected when there is a macerated fetus, or in case of twins, or where the presenting part has sunk deep in the pelvis, or where the amniotic fluid is small in quantity; neither is it practicable, as a rule, where an excess of fluid causes marked tension of the uterine wall, as in such cases the fetus cannot be retained in its new position. It is seldom adapted to cases where a rapid termination of the delivery is indispensable. Malformations of the uterus and tumors are rare contra-indications.

There is no *danger* connected with this operation. Its manifest advantages are that neither sepsis nor shock can result from its use.

The best *time for operation* is at the end of pregnancy, just before the onset of labor, because, later, uterine contractions impede the maneuvre. Earlier, as at the seventh month, one sees transverse presentations in the multipara that rectify themselves, but version may be undertaken early, or, indeed, at any time during the first stage when the conditions above mentioned exist. If begun during labor, the manipulations should not be persisted in so long

that the uterine wall takes on firm and persistent contraction—a condition which renders the other methods very difficult.

Preparation for External Version.—The bladder and the rectum should be emptied, and the woman placed in the horizontal dorsal decubitus, the head and shoulders moderately elevated, and the lower limbs slightly flexed with the knees apart. Anesthesia is not required unless the patient is extremely sensitive.

Steps of the Operation.—The hands are applied to the bare abdomen and the diagnosis is carefully confirmed. A hand is then placed on each end of the fetal ovoid. In transverse cases the head is lifted toward the fundus and the breech is driven down toward the inlet by a succession of moderate impulses which are checked as soon as a uterine contraction is produced, while whatever gain has been made is carefully held until the uterine wall again relaxes. A method that has merit is the following: The operator seizes the opposite ends of the fetus with the palms of his hands facing each other, the fingers of one hand opposite the wrist of the other, the hands lying parallel. The power is exerted by simple flexion of the fingers moving in unison, and although the position of the hands may seem forced, they will be found to work easily (Fig. 257). Alternating pushes, first on the head and then on the breech, most readily dislodge and turn the child. These strokes are made in rapid succession upon the two extremities, one hand giving a movement of ascent and the other a movement of descent. Cephalic version should first be tried in transverse presentations wherever the pelvis is sufficiently large and it is not likely that hasty extraction will be required, or the tampon action of the leg will become necessary as in placenta prævia.

FIG. 257.—External version: arrows show the direction in which the ends of the fetus should move.

If it is attempted to replace a breech by a vertex presentation, the first step of the operation consists in lifting the breech into one iliac fossa while at the same time the head is driven to one side. As in all other methods, the end of the child to be brought down is made to follow the shortest possible arc that will bring about the desired result. This will be accomplished by pushing the head in the direction of the occiput and the breech in the direction of the feet. Patient and repeated attempts should be made, but the woman should not suffer pain, though she may be subjected to some discomfort. When the turning is effected, a vaginal examination is to be made to make sure that the desired fetal pole has been brought to the inlet.

Retention after Version.—Having succeeded in altering the presentation, it will be found that the causes which produced the former presentation will tend to reproduce it; therefore we either bandage the abdomen to retain what we have gained, or, if labor is under way, we make sure that the presenting part becomes well engaged. The bandage may be one of two kinds—either an impromptu affair of flannel or of unbleached muslin, like the ordinary binder, to which a longitudinal pad on each side is carefully fitted and fastened, or one of the abdominal bandages to be found in any large instrument-store, reinforced, if necessary, by lateral splints or padding. Pinard's bandage has long inflatable pads on the sides and straps under the thighs. If labor is under way and the new presenting part does not engage well, the patient may remain on her back, watched by the obstetrician or the nurse, or on that side from which the presenting part was dislodged, with a firm pillow under the uterus to prevent undue sinking. In certain cases it is advisable to rupture the membranes to make sure that the child remains in the desired position.

2. Bipolar Version.—*Indications.*—The foregoing general rules apply also to the bipolar method of version. The special conditions necessary are that the liquor amnii be wholly present or so recently present that the child is still movable in a fair degree, and that the cervix admit two fingers, while the vagina must tolerate the presence of the rest of the hand if necessary. "It is one of the natural consequences of a shoulder presentation that the cervix is but rarely found dilated enough for turning and delivery until after, perhaps long after, the indication for turning has clearly been present. The shoulder does not dilate the cervix well."

The *advantages* of the bipolar method over the internal method are that there is less danger of infecting the uterine cavity in its deeper parts, and that it permits the operation to be done when the dilatation of the cervix is but slight. Its *disadvantages* are that the finger-tips have but a limited control over the parts of the child that successively come within reach, and the method is therefore usually restricted by its limitations to those transverse cases in which one has not far to reach or far to turn in order to bring the child's knee into the cervix; nevertheless this resource should always be kept in mind.

The preferred *time of operation* is early in the dilatation stage when the cervix is passable for two fingers.

Preparation for Bipolar Version.—Anesthesia is not necessary nor usual, but it should be a preliminary procedure with an excessively sensitive or restless patient. The parturient lies on her back across the bed, with her hips near the edge, and her feet on the edge of the bed or supported by assistants or on chairs. Working short-handed, one may pass a rolled sheet under the patient's neck and tie the ends about the knees, to keep them flexed. The forceps is wrapped in a towel and boiled, to be at hand in case arrest of the after-coming head should suddenly demand it for a difficult extraction. With the forceps, scissors, episiotomy knife, needles, needle-holder, catch-forceps for

quick seizure of the cord, douche-bag and tube, tape, and silk or silkworm gut are sterilized by heat. The douche-bag is filled. Towels, steamed, fresh-laundered, or wrung out of solution, gauze, iodoform or zinc-oxide gauze for tampon, basins, and solutions are ready for use. The diagnosis is confirmed; the hands of the operator are rendered sterile, the vulvar hair is clipped close, and the vulva and its vicinity, the lower abdomen, the inner sides of the thighs, and the vagina and cervix are lathered and douched.

Steps of the Operation.—The fingers of the hand that correspond in name with the side of the mother to which the presenting part is to be pushed—the left hand if the shoulder is to be pushed to the left—are slipped through the cervix into the uterus, the remainder of the hand being inserted into the vagina only when the presenting part is at such distance as not otherwise to be reached. The outer hand grasps that end of the child which is to be brought into the cervix. A simple and efficient way to keep this hand from contamination is to wrap it in a sterile towel or to lay across the abdomen of the mother a towel wrung out of a warm disinfectant solution.

Let us suppose that we have a vertex presentation, the occiput to the left and front, to be changed to a breech presentation. The head must be sent in the direction in which the occiput points—in this case to the left. We now begin "the simultaneous action on the two ends of the fetal ovoid, the fingers of the internal hand pressing the head-globe across the pelvic brim and lifting it upward toward the left iliac fossa; the hand outside pressing the breech across to the right and downward toward the right ilium (Figs. 258, 259). The movements by which this is effected are a combination of continuous pressure and gentle taps with the finger-tips on the head, and a series of half-sliding, half-pushing impulses with the curved hand on the breech" (Barnes). As the head is lifted out of the brim on to the shelf of the iliac fossa and is passed on, the shoulder moves along into its place. Then the chest, elbow, or knee comes within reach, but further away and at times almost too high for touching. When the arms and legs are completely flexed the knees of the child are found about the height of its navel or against its chest. Meanwhile the outer hand crowds the breech well downward to bring the knee within the grasp of the fingers passed into the uterus, and the nurse or assistant is requested to lift the head upward. As soon as a knee comes within reach it should be seized. When a choice can be made, the lower or near knee should be chosen in a dorso-anterior position of the child (Fig. 262), and the remote knee in a dorso-posterior position; that is to say, the lower of the two in the case we are considering. Often one cannot choose, but breaks through the membranes (if they are intact) and gets down either leg or both legs without ado, as the finger-touches cannot determine the matter so readily as does the full hand-grasp of internal version. [A full consideration as to the choice of foot is found on page 478.] Still applying power to the ends of the fetal ovoid, the version is completed by drawing the leg down into the vagina to secure the engagement of the breech. If the arm is

prolapsed, Braxton Hicks advises that it be flexed and pushed up over the anterior surface of the thorax, first noosing a fillet about the wrist. In applying the above method to a transverse presentation (Figs. 259, 260) the steps we have described are undertaken so far as they apply—that is, one begins by tossing along whichever part first comes within reach of the inner fingers. Moreover, while we have described podalic version because it is the more common, cephalic version can be accomplished by the same procedure.

3. Internal Version.—By this method, which is the most effective and the most commonly employed, as well as the most dangerous, the hand is passed into the uterus deeply enough to seize one or both feet and to bring

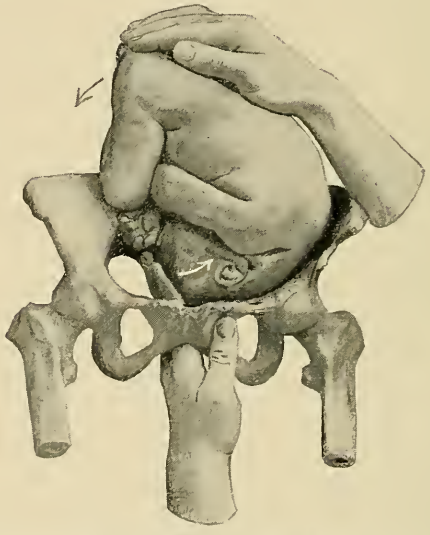


FIG. 258.—The first step of bipolar podalic version: two fingers within the cervix lift the head toward the iliac fossa, while the breech is crowded over toward the other ilium.

them through the cervix. The *indications* are those already described on page 470, and the same may be said of the contra-indications, with emphasis on the fact that the reasons there given apply with their fullest vigor to this method, which in neglected cases may constitute a difficult and hazardous operation.

The *conditions* necessary for the performance of internal podalic version—and podalic version is practically the only variety undertaken by this method—are rather numerous:

1. The mother must not be in gravest danger, for in such case version cannot save her. The child is likely to be so weak as certainly to die during the process of turning and extraction; and the fetal life could only be saved by Cesarean section immediately following the mother's death.

2. The pelvis must be sufficiently ample to allow free passage of the hand, so that the fetal part can be grasped securely and the living fetus extracted.

For the live child a true conjugate of not less than 8 centimeters (3¼ inches) will be desirable with a fetus of ordinary dimensions.

3. The cervix should be completely dilated, or in a multipara almost completely dilated, and at the least be freely dilatable and easily passable for the hand without injury; for if rapid extraction is necessary the cervix must permit ready passage of the head, and to secure this it should be large enough to allow the closed fist to pass. A note must always be made in passing of the size and dilatability of the orifice, for there is no more annoying obstruction than to find the after-coming head firmly retained by a powerful india-rubber-like band applied about the neck.* Where the dilation is not complete version is not forbidden, for we resort to it in cases of placenta prævia in

FIG. 259.—Bipolar version: the shoulder and arm are pushed along; the breech is pushed downward.

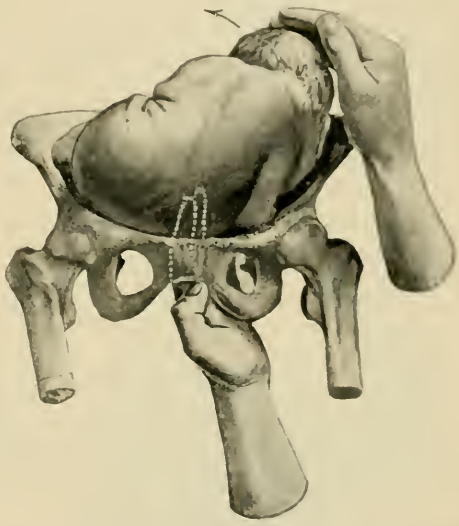


FIG. 260.—Bipolar version: the knee is almost within reach, the head is pressed upward.

order to plug the bleeding canal by the thigh or the breech and wait for dilatation, and we are not deterred by the case wherein the elastic tube fits the head snugly, because incisions will permit us to extract rapidly if this become imperative.

4. The uterus must not be tetanically contracted about the child, for under such conditions there is imminent danger of rupture; therefore the obstetrician tries to ascertain whether there is a transverse ridge, the retraction-ring, between the symphysis and navel, and how high up it has been drawn.

5. The child should not be crowded too deeply into the pelvis, but should

*The circumference of the cone-shaped hand is from 20 to 24 centimeters (8 to 9½ inches), that of the closed fist from 25 to 28 centimeters (10 to 11 inches), while that of the flexed head is from 30 to 33 centimeters (12 to 13¼ inches), so that the closed fist should pass loosely to ensure rapid extraction of the after-coming head.

be sufficiently movable to allow the presenting part to be pushed back. Neither must the fetus be too large. If premature (before twenty-eight weeks) and dead, and macerated, no operation is likely to be needed. Most favorable will be the case wherein the child is relatively small, the uterus lax, the cervix open, the membranes intact, and the mother insensitive.

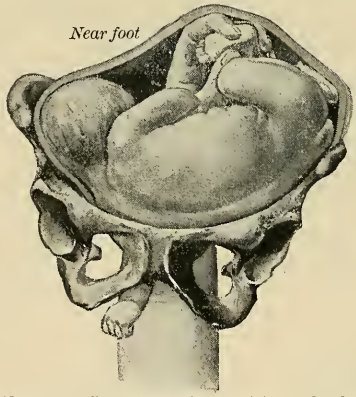


FIG. 261.—Dorso-anterior position: the hand is passed directly across the child to seize the *near* foot.

Dangers of Internal Version.—The dangers, as has been said, are rupture of the uterus from the employment of undue force, and sepsis caused by uncleanliness, together with laceration, hemorrhage, and shock.

The *advantages* of this method are the complete control of the fetus and its evolutions which it affords.

Choice of Foot.—Before proceeding to operate, we must have a clear idea of

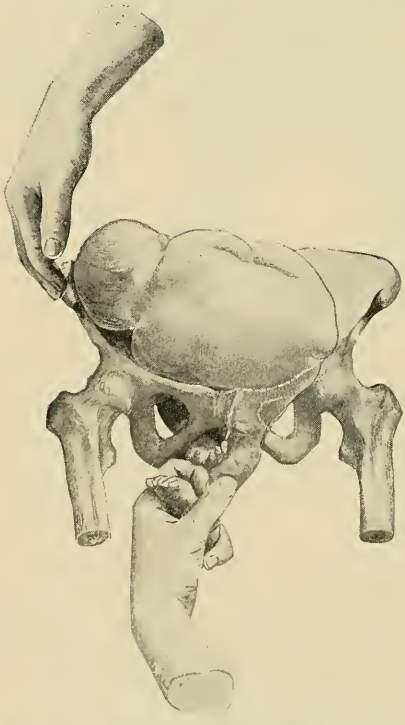


FIG. 262.—Traction on the near leg is made diagonally across the mother's pelvis to pull the child's breech into the inlet.

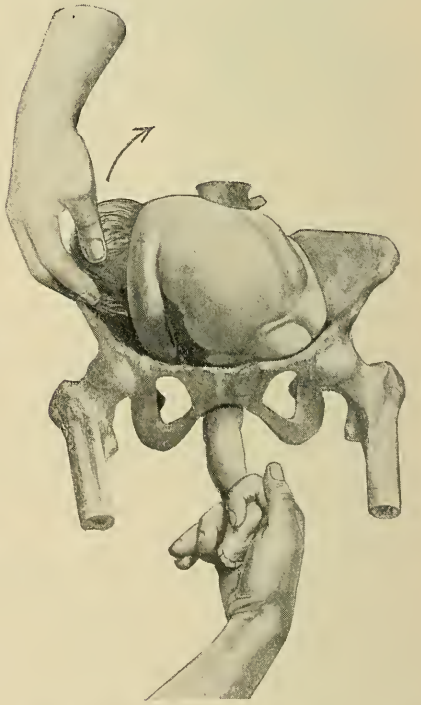


FIG. 263.—Traction made directly downward leaves the breech seated on the iliac fossa and requires useless force.

the mechanism we desire to institute, and we shall diverge from our practical study to consider conflicting theories and teachings, since there is much differ-

ence of opinion as to the most advisable, expeditious, and successful method. The question at issue is whether to seize one or both feet, the near or the remote foot, or the remote foot in certain cases and the near foot in certain other cases. We state, theoretically, the most advisable method, but we do not pretend to make hard-and-fast rules. In practice we often do—not what we would, but what we may. We may summarize the discussion by saying that traction on either foot will rightly effect the version, but that it is preferable to bring down the remote foot in dorso-posterior positions of the child, and the near foot in dorso-anterior positions.

The simplest method is to seize *either foot* indifferently. Some operators (Nagel, Grandin, Fritsch) endorse this practice. In the most difficult cases where the pressure of quick-recurring uterine contractions or the emergency during a hemorrhage is such that one is happy to be able to reach either lower extremity; or in case only one can be found; or with an operator who has not been thoroughly trained by manikin teaching or who is without sufficient experience and possesses cloudy ideas of position and mechanism,—this course is a sensible one to advise. Traction on either leg will bring about version. It is merely a question which leg will most efficiently produce the desired

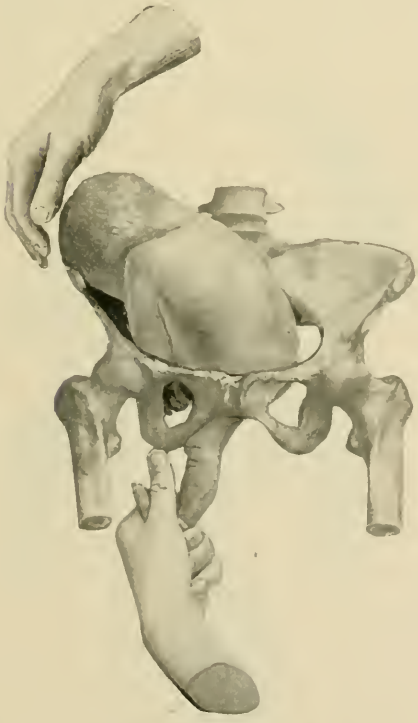


FIG. 264.—The breech enters the pelvis with traction in the right direction.

FIG. 265.—New seizure on the thigh: the leg on which traction is made being the anterior leg in the pelvis.

result; therefore, for the novice let us say that either foot should be seized if he is unable to get both.

The *near foot always* is chosen by certain operators (Winckel, Lusk,

FIG. 266.—Dorso-anterior position; seizure of the *remote* foot.

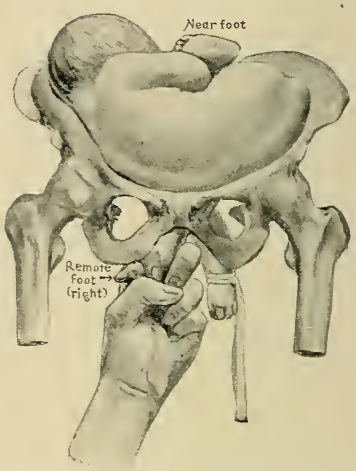


FIG. 267.—The remote foot drawn in a diagonal direction through the mother's pelvis.

Schroeder, Galabin), except with a freely movable child, because it is simpler

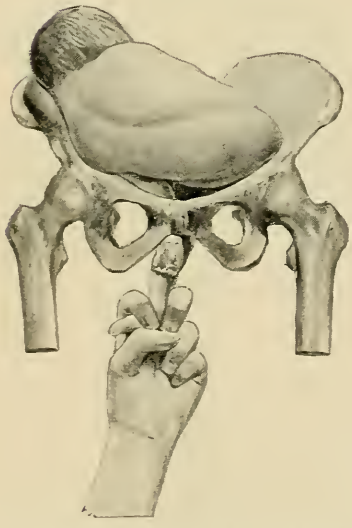


FIG. 268.—The upper buttock is moving downward and the lower shoulder rising.

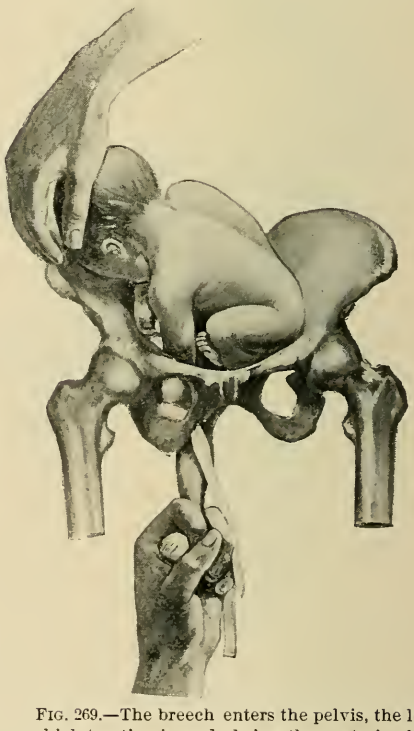


FIG. 269.—The breech enters the pelvis, the leg on which traction is made being the posterior leg in the pelvis.

and less difficult, and because "only a revolution (Figs. 261–265) about the

child's sagittal axis occurs, to which is added later one about its long axis, when the hip which has been brought down engages under the symphysis." In pulling on the upper foot "a revolution (Figs. 266–271) about the long axis, and then one about the sagittal axis, and finally a short revolution about the long axis of the child occur, and a disastrous lifting of the arms is produced." This objection to traction on the remote leg has force in dorso-anterior cases only.

The *remote foot always* is sought by certain teachers (Simpson, Kristellar, Barnes). "The proper knee to seize is that which is farthest. We have, for example, a right dorso-anterior position (Fig. 266); the right arm and shoulder are downmost, and these parts have to be lifted out of the brim. How can this be done? Clearly, by pulling down the opposite knee, which, representing the opposite pole, must cause the shoulder to rise, the movements running parallel in opposite directions like the two ends of a rope around a pulley" (Fig. 268). "If only the foot of the same side as the presenting arm is seized, the effect is to increase the wedge and the impaction." In Figure 262 it will be seen that traction on the leg is like pulling on the stalk of a T, of which the horizontal bar is represented by the body. Moreover, in transverse cases the breech is usually further from the median line than the head, and the near leg may pull in the long axis of the child at a disadvantage.

The inadvisability and the bad mechanics of traction on the posterior leg, as compared with traction on the anterior leg, are well shown in Figure 279, (A-C). It needs but a glance to see that the pull in the direction of the

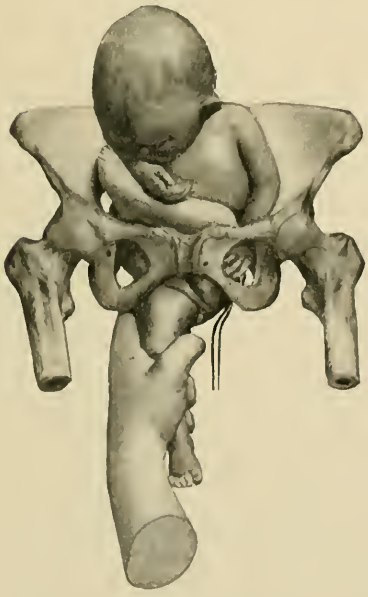


FIG. 270.—The leg on which traction is made has passed over from the left to the right side of the mother's pelvis.

FIG. 271.—The leg which was posterior in Figure 269 is now anterior.

arrow of Figure 279, A is at an angle which in no way coincides with the

axis of the inlet of the pelvis, whereas the pull indicated by the arrow in Figure 279, C, is at a much more favorable angle. Figure 279, B, shows rotation under way. Nagel demonstrated clinically that the leg swings the long way round the mother's pelvis.

The Near Foot in Dorso-anterior Positions—The Remote Foot in Dorso-posterior Positions.—In dorso-anterior positions the near leg should generally be brought down. A strong argument in favor of this method may be drawn

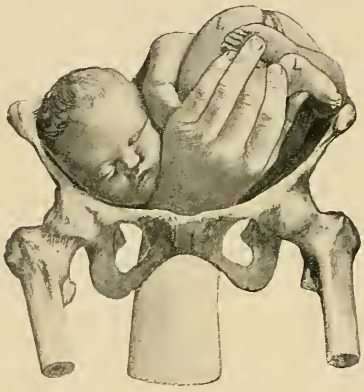


FIG. 272.—Dorso-posterior position: the hand is passed in directly to seize the remote foot, the mother in the dorsal posture (see Fig. 281).

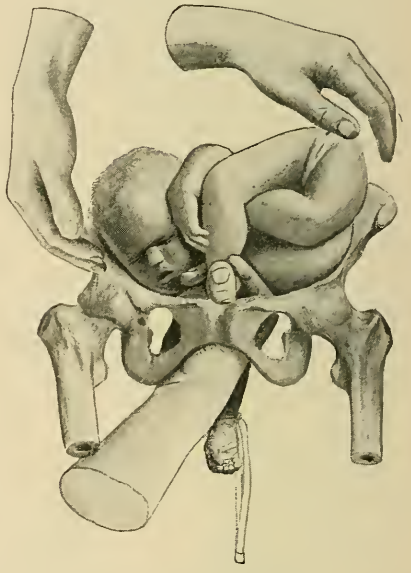


FIG. 273.—The foot is drawn down; assistance by means of the hands without is shown.

from these two facts—first, that in pulling the breech through the brim after turning, it is of great advantage to make traction on the leg which will come at once to the front behind the symphysis, and secondly, by this means the fetus never loses its dorso-anterior position. But in bringing down the upper foot the child's face is turned to the front, requiring a subsequent rotation of the trunk to bring about a dorso-anterior condition, which is required at a further stage of the extraction in order readily to deliver the shoulders and head. This will best be demonstrated by consulting the two series of figures (Figs. 266–270) illustrating the stages of the procedures here set in order. It will be seen that one evolution is simple and that the other is complicated; that in one case the rotation of the body on its long axis is entirely avoided; and that a very important consideration argues for the simpler procedure—namely, that the chances of throwing the arms above the head are materially lessened by the method of traction on the near foot. When there is firm contraction of the uterus it is rightly objected that pulling on the near foot will more tightly wedge the parts, and that it will be necessary to push the head higher up in the iliac fossa in order to loosen the obstruction. But

in the presence of such relaxation as would justify version the simpler method is advisable.

In dorso-posterior transverse positions the remote leg should be brought down. Here the back of the child is at the rear, and traction on the upper leg after the change in the long axis has been effected will bring about an anterior position of the dorsum of the child. To secure this condition promptly, the upper leg is the one to seize, as shown by our graphic argu-

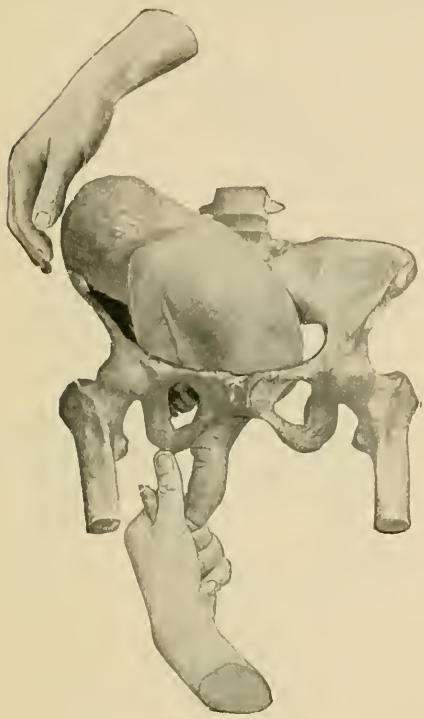


Fig. 274.—Traction is made diagonally across the mother's pelvis to dislodge the breech; the leg brought down is now the anterior leg.

Fig. 275.—The child slips farther down.

ments (Figs. 272–275). As one pulls on the remote foot the body rolls over, the upper buttock follows over a course toward the front and becomes lower than its fellow, while the spine is strongly curved. Imagining the fetal trunk to be a flat block of wood, the traction on the upper or sacral corner of the block forces the diagonal, or opposite, corner—the impacted shoulder—to rise.

A Single Foot.—The advantage of bringing down one foot instead of both feet is that the second leg applied along the fetal trunk ensures a larger mass (made up of the breech and the flexed thigh) by which the cervix will be wedged more fully open for the benefit of the larger after-coming shoulders and head, than will be the case where this wedge is decomposed and both legs are brought down, leaving a dilating mass of the calibre only of the child's hips. The circumference of the hips, with both legs down, is somewhat over 25 centimeters (10 inches), while that of the breech, with one leg up, is 28 to 30 centimeters (11 to 12 inches).

Both Feet.—When the cervix is widely dilated, when the most rapid extraction is called for, or when the uterus is not well relaxed, both feet may be brought down. The middle finger is passed between the child's ankles when seizing both feet, and the other fingers surround the ankles. If seizure of the foot is difficult or if straightening of the leg is impeded, the leg may be brought down by making pressure in the popliteal space, thus flexing the thigh alongside the trunk toward the back and side of the child and giving more space in which to pull down the foot (Fig. 280). In some cases the finger may be hooked over the knee, and the knee drawn downward in a flexed condition, extension of the foot being effected farther down in the birth-canal, but usually this method is troublesome.

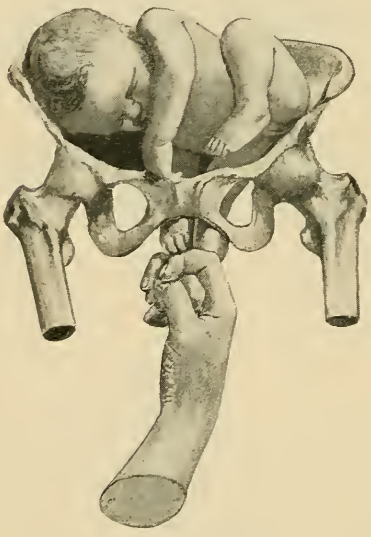


FIG. 276.—Dorso-posterior position: the rear leg has been brought down.

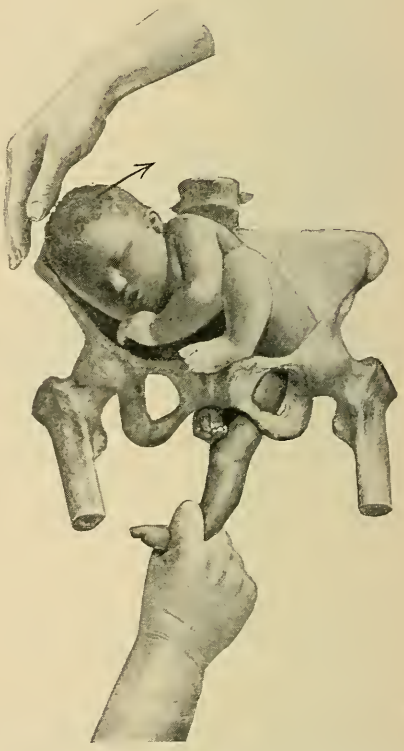


FIG. 277.—The child's breech enters the pelvic cavity.

In all the above difficulties the outer hand supplements the work of the inner hand, pushing or feeding the desired part within reach of the fingers working in the uterus.

Choice of Hand.—No stress is laid on the choice of hand, because the feet of the child usually lie within equally easy reach of either hand, near the center of the uterus. The hand that is most readily used depends somewhat on the position in which the patient is to be delivered. In general one chooses that hand which, in a given case, will most conveniently pass in to the leg to be brought down, in such a way that the sensitive surface of the fingers will be turned toward the part to be examined and grasped—the palm toward the child's abdomen. Thus in the case shown in Figure 261, the patient

in the dorsal posture with the fetal abdomen to the rear and the feet to the mother's left, the left hand works more easily into the deep hollow behind the child. In dorso-posterior positions, or in cases of pendulous abdomen, there is often difficulty in passing the hand into the cavern above the symphysis because of the troublesome backward bend at the wrist-joint (Fig. 272). In such conditions the latero-prone posture is of value, in combination with the expedient of passing the hand along the lower lateral wall of the uterus, the patient lying on that side on which the child's feet are situated (Fig. 281).

Preparations for the Operation.—Internal version may be undertaken in an emergency with no assistant except a nurse, but one works at a great disadvantage, and would prefer to have one medical man as anesthetizer, and a second to assist, besides the nurse, who will have enough to do in carrying out directions that may be given her. Whenever possible the operation should be performed on a table. A large enema should always be given. The catheter should be used if sitting on the chamber and the application of hot cloths to the vulva fail to induce an evacuation of the bladder.

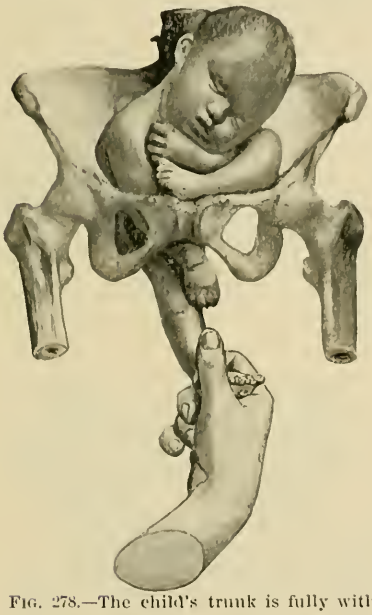


FIG. 278.—The child's trunk is fully within the pelvis, but further rotation is necessary to bring the leg to the front.*

To prevent undue soiling of the bed, the floor, or the operator's person—for this is one of the bloody operations—some ample receptacle, such as a pail, dish-pan, or child's bath-tub, should be placed on the floor, and to guide the fluids into the vessel a Kelly pad, or a waterproof, or table cover, or some newspapers under sheets should be spread beneath the hips. Over these and next to the patient a sterile towel or one wrung out of an antiseptic solution should be laid. The operator protects his clothing with a rubber apron or by a sheet tied under the arms.

A well-equipped instrument-table will contain a large basin of hot water for the scrubbing or to resuscitate the child, a basin of antiseptic solution in which the uterine douche-tube, connected with a filled douche-bag, may conveniently lie; green soap and brushes; gauze or towels to be used as sponges and in seizing the child; a bandage or strip of gauze; a fillet; scissors; silk or silkworm gut for tying the cord; an episiotomy knife for the cervix or vulva, and forceps for the after-coming head. The assistant who administers the ether is at hand with restoratives, a hypodermic syringe, and ergot.

* I am indebted to the beautiful work of Farabeuf and Varnier for the suggestions from which many of the illustrations to this article were made. For all of my cuts photographs of the pelvis and fetus were taken and painted over (Robert L. Dickinson).

Anesthesia is required for all sensitive patients in most of the difficult operations and whenever complete relaxation of the abdominal and uterine walls is essential, because the walls of the cavity become tense as the hand pushes in, and may take on a more or less continuous form of contraction. Narcosis is usually desirable to relieve the pain of the operation and to prevent struggling on the part of the patient. It is to be omitted where such favorable conditions as the open vulva of the multipara, a fully dilated cervix, and flabby and insen-

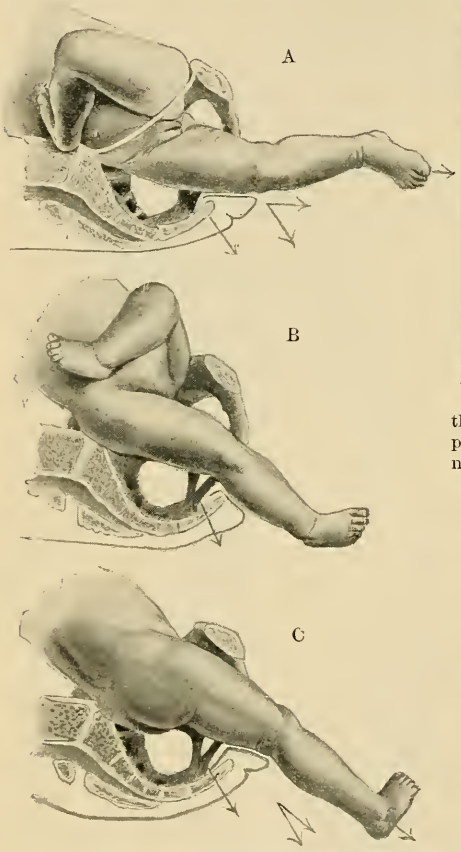


FIG. 279.—A, traction on the posterior leg; the lower arrow shows the axis of the inlet, the arrows to the right, the axis of traction; the buttock is caught on the brim. B, continued traction is rotating the leg to the position of C. C, traction on anterior leg: the arrows show that the pull is nearly in the axis of the brim (modified from Farabeuf and Varnier).

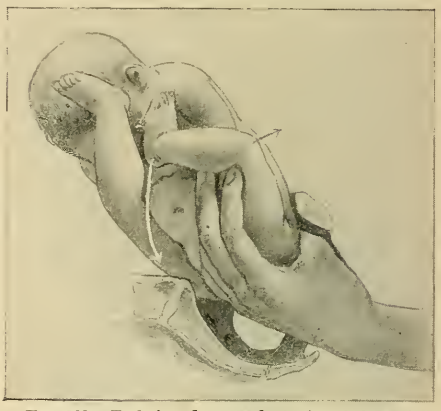


FIG. 280.—To bring down a foot when it is against the face the knee may be bent by pressure in the popliteal space (modified from Farabeuf and Varnier).

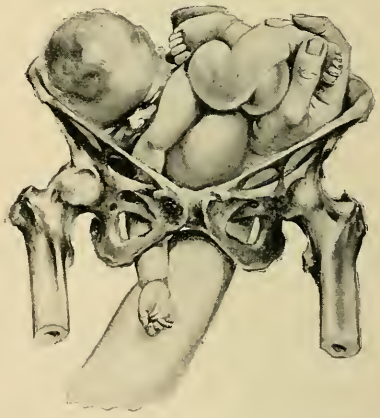


FIG. 281.—Dorso-posterior position: the hand passes easily along the side wall of the uterus to seize the feet.

sitive uterine and abdominal walls are present, or when serious heart disease forbids its use. It may be discontinued as soon as turning is accomplished. Ether produces less complete relaxation than chloroform.

In no obstetric operation is thorough *antisepsis* more urgently demanded. The operator's sleeves are rolled up nearly to the shoulder and pinned, a rubber apron or a sheet is fastened about him, and his hands and forearms are thor-

oughly scrubbed. Then the hair is clipped, and the vulva, the inside of the thighs, and the abdominal wall are lathered with gauze, soap, and hot water. Scrubbing should be done with a brush after anesthesia is under way. This cleansing is eminently desirable, because occasional contact with the skin-surface is hardly avoidable. In cases of haste or in an emergency there may only be time enough to scrub off the vulva and to wrap the outer manipulating hand in a clean towel. The desirability of keeping that hand aseptic is evident from the frequent necessity for a change of hands by which the outer becomes the inner hand at a time when valuable minutes would be lost in cleaning a contaminated outer hand.

Next, the vagina is well lathered with a wad of gauze and green soap, every fold being stretched and scrubbed. The douche is then given. If time and material serve, each leg should be rolled in a separate sheet and the covering secured with safety-pins. In our hospital work the patient wears a pair of combination stocking-drawers tied about the waist. The sheet-sling (Fig. 282) is employed when working short-handed. A clean towel, or one wrung out of an antiseptic, on a chair or table, holds the instruments, which have been wrapped in another towel, and which have been boiling ten minutes while the patient was being shaved and anesthetized.

Posture of the Patient: Flexed Dorsal Posture.—Usually the patient is laid with buttocks close to the lower end of the table or across the bed, her thighs flexed and supported by assistants, or, in cases in which the operator works very

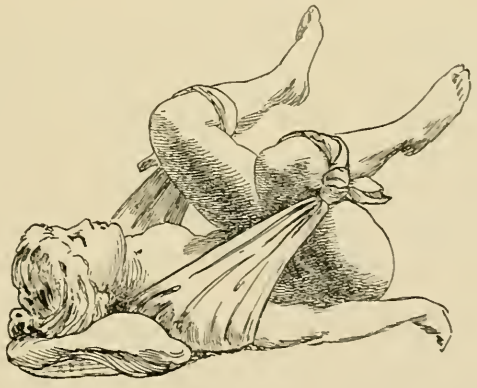


FIG. 282.—Sheet-sling applied broadly and properly to shoulders and tied below and outside the knees; thus the knees are held apart, and the patient can elevate the feet very little.

short-handed, by the sheet-sling (Fig. 282). The shoulders may be low; a pillow under the hips covered with water-shedding material will lift the pelvis advantageously, and a light blanket protects the body from chilling. This posture is most commonly employed, because it is the only one that allows free play to the outer hand; the chances of infecting the outer hand are lessened; if working alone, one can better direct the anesthetic and watch the breathing; and extraction can be completed in the position in which version has been accomplished. By reference to the series of cuts of postures it will be seen

(Figs. 296–301) that, with the thighs nearly full flexed, for internal version the route to the fundus is direct.

The Hanging Dorsal Posture.—When extracting the after-coming head, or whenever additional space in the conjugate diameter of the brim is demanded,—6 to 9 millimeters ($\frac{1}{4}$ to $\frac{3}{8}$ inch),—the thighs may be extended to their utmost over the edge of the table or bed. This is the hanging dorsal or *Walcher* posture (Figs. 294 and 299). It will be seen that the axis of traction at the inlet in this posture is almost directly downward.

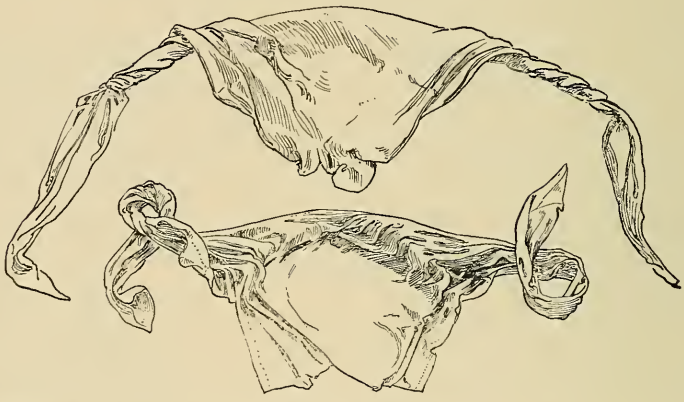


FIG. 283.—Sheet-sling, in shawl shape, bearing on the shoulders rather than on the neck. Before and after using (see Fig. 282).

Arched Dorsal Posture.—For convenience of access to the fundus from below, and for better relaxation of the uterus, the combination of the inclined dorsal, or Trendelenburg, and the hanging dorsal, or Walcher, postures is efficient. The patient is so hung over the incline of the operating table that her sacrum rests on its upper edge, or else she is made fast to the back of a tilted chair, as fully described on page 502 (Figs. 294 and 300). This posture has some of the relaxing tendency of the knee-chest attitude, and furnishes a straightened birth-canal with a vulvar opening at a most convenient height.

Latero-prone Posture.—If the patient is placed on her side, as is advisable in dorsoposterior positions, it should be on the side on which lies that end of the fetus which it is desired to bring down; that is, when the breech is to the right the mother should be placed on the right side. By this method the operator stands behind or in front of the patient in such a way that he faces in the same direction as the child. The necessity for the operator to assume these positions is somewhat less imperative if he proceeds by slipping his hand beneath the child along the lateral aspect of the uterus, since he can then easily pass his hand in either direction (Fig. 284). This method is particularly available in dorsoposterior positions and in cases of pendulous abdomen, because in these one can reach into the bay-window-like uterine cavity above the pubes to seize the feet without that distressing backward bend caused by the overextension of the wrist-joint about the symphysis

that is required in operating in the dorsal position (Fig. 272). The right hand would naturally be employed with the patient on her right side, and *vice versâ*. Later, when the feet have been drawn well down into the vagina, the patient may be turned over on the back to facilitate the external manipulations necessary to complete the turning.

Knee-elbow Posture.—This attitude should be chosen in difficult cases when the presenting parts are snugly fitted into the inlet. It occasionally yields brilliant results, rendering version possible when the fetus could not be dislodged in any other posture of the mother (Fig. 301). One of the disadvantages of this posture is that unless the mother be supported anesthesia is not available. The writer has been able to hold patients in this position by swinging a sheet between the backs of chairs placed on either side of the bed, directing the patient to bend herself double over this hammock, and operating over the foot of the bed near which she knelt.

FIG. 281.—Lateral posture for version: the hand is passed along the side wall of the uterus to the feet. Better adapted to dorso-posterior positions.

Trendelenburg Posture.—This posture is available for anesthesia, for which the knee-chest attitude is almost out of the question. The necessary inclined plane is easily improvised by turning a chair on its face, as shown in Figure 305. If internal version is to be done in this attitude, a chair without rungs must be used, the buttocks must lie against the back edge of the chair-seat, and the thighs be tied to the back legs to allow working space between the thighs.

As a general rule, it is wise for the operator to use that position with which he is most familiar.

The *squatting position* in its most extreme form, when the thighs are strongly applied to the sides of the abdomen, is said to have some effect in diminishing the transverse diameter and increasing the longitudinal diameter of the uterus, and might be tried before other measures.

Examination.—Whenever external examination has left any doubt as to the exact position of the child, the fingers, or even the whole hand, passed into the uterus will yield the desired information. During this search the rate of pulsation of the cord may cautiously be determined and a low implantation of the placenta be recognized.

Steps of the Operation.—The steps of the operation are four in number: (1) The introduction of the hand; (2) recognition and seizure of one or both feet; (3) turning of the child; (4) extraction of the child.

After completing the preparations just described and having confirmed the diagnosis of position, the obstetrician determines which hand to use and which

foot to seize, and whether to pass the hand along the back or front or alongside of the fetus. He nooses a fillet on the child's wrist if the arm is in the cervix, and he proceeds with the first step of the operation, which is the—

Introduction of the Hand.—The sterile hand is anointed on its external surface with vaselin, unless a lubricating antiseptic solution is used, such as 1 per cent. creolin or lysol; the tips of the fingers and thumb of one hand are so placed together as to form a cone; the vulva is drawn wide open with the fingers of the other hand, the operating hand being slowly pressed through the vulva by a rotary motion. To pass the hand in front of the fetus the elbow should be brought down low, even if it is necessary to kneel to do so. To pass the hand in behind the child, the fingers should be slipped up to one side of the promontory, which may seem to jut further forward than normal because it can be so plainly felt. The operator should push steadily but gently through the cervix, and having passed that opening should flatten out the hand and "slowly slip it along without violence, without hesitation, steadily upward to the fundus, interrupting its progress only if a contraction commences, and quietly awaiting its passing away before further advance."

If the membranes are unruptured, it is advisable to break through them a short distance within the cervix, unless pulsating loops of cord are detected. In the latter case a new and more circuitous path toward the foot may be chosen before rupture. One is loath to let part of the waters drain away, with the possibility of bringing the cord down, but when the hand is passed deep between the membrane and the uterine wall, it is difficult or impossible to determine quickly what part one seizes through distended membranes. Working within the amniotic sac leaves an important natural covering on the uterine wall and protects the uterus against contact and infection.

The operator's fingers are held together to prevent the cord from slipping in between them. The hand may keep to the side of the child's body (Fig. 281), particularly in oblique cases, to avoid the cord, as the latter is easily compressed if the hand is passed roughly across the child's belly. Compression of the cord is avoided whenever possible; if unavoidable, the remainder of the operation is hastened. "From the time one commences to penetrate into the uterus, happy to be able to push aside the engaging part, always watching to employ a force that is moderate, but continued and real—the other hand, free to act without, is applied over the fundus to slide the breech downward and to bring it to meet the hand within. Without this support the upward pressure of the inner hand might rupture the uterus or tear it from the vagina" (Farabeuf and Varnier.) When the hand has been introduced along the child as far as the navel the knees will be encountered. The feet are usually found near the fundus, applied to the child's breech. In a few instances the feet of the child are against its face, or its knees are within easy reach of the entering hand; under such conditions the fingers need make but a short excursion into the uterine cavity. In most cases, however, one must push on frankly and fearlessly to the fundus, and need not hesitate to slip the arm into the vulva up to the elbow, in order that the finger-tips may

reach well beyond the fetus (Fig. 261), and readily curved backward to secure a firm hold on the feet; "lacking this there is no easy going. One wanders vaguely below the level of the feet, hesitating. Deep in the uterus, on the contrary, one readily seizes the feet, and from that moment is master of the situation" (Dubois; see Figs. 266, 281). The early mistake of students and practitioners on the manikin, and of internes in the wards, according to the writer's experience, is to waste time in half-hearted and fruitless attempts to seize parts of the infant out of reach.

Seizure of the Foot.—At this stage the operator should pause to examine the large number of limbs that seem to be crossed in front of the child, in order to distinguish the hand from the foot, and, if desired, between the near and the remote foot. The foot is readily recognized by the large knob of the heel. The flexed knee points toward the head, the flexed elbow toward the breech. Nothing need hurry one except the numbing of the operator's hand under pressure. It is embarrassing to pull down an arm. If but one foot is found, it should be seized; if both feet can be had and the cervix is wide, both may be brought down. The foot is to be seized between the bent index and the middle finger, one over the projecting heel, the other over the arch (Fig. 268), or, indeed, in any possible manner (Fig. 273).

FIG. 285.—A catch-forceps seizes the loop of bandage to slip it up over the ankle.

Turning.—The operator now draws the leg downward to the sacral hollow and across the patient's body in the direction of the child's head (Fig. 273). If the breech is to enter the pelvis on the mother's left side (Fig. 262), he should pull across to the right, while at the same time the external hand is pushing the head up toward the fundus with considerable vigor (Fig. 264). The assistant's hand may well be employed, meanwhile, in pressing the breech downward. After the foot has been drawn well downward and version cannot yet be effected, before attempting to grasp the other foot one should secure the first foot with a fillet passed by means of a catch-forceps (Fig. 285) up over the wrist of that hand of the operator which holds the foot, and fastened about the ankle. Failing still, the inner hand lets go the foot; the outer hand, steadying the breech and pushing downward, slips along to the shoulder and head and pushes up between the pains, returning to pull upon the leg. Or, better, a fillet made fast to the foot is seized by the outer hand, which draws the foot down through the vulva, while the inner hand is pushed deep in to lift up

the shoulder and head, the assistant meanwhile helping as he may externally; but all the precautions we have mentioned should carefully be observed to avoid injury to the uterine wall.

If, in any of these procedures, an arm slips down or a hand is brought down by mistake, a noose is made fast to the wrist in order to prevent the extension of this arm and its elevation above the head during extraction. In some cases when the child is in the transverse position the humerus may be used as a lever to shove the shoulder up and along. The hand invariably becomes numb in a short time, and must be changed for the other hand. The operation is complete when the child's breech is engaged in the pelvic inlet. To bring the feet through the vagina and out of the vulva, one will have to resort to seizure with a towel, or to the noose about the ankle, the slippery skin of which not affording a good hold to the tired hand.

Immediate Extraction versus Delay.—Having completed the version, one carefully examines the fetal heart and considers the mother's general condition, to decide whether the child shall be delivered at once or whether its expulsion shall be left to nature. In any condition threatening grave danger, such as excessive loss of blood from placenta prævia, threatened rupture of the uterus, slow or very rapid fetal heart (near 100 or close to 200), immediate extraction is advisable. When the cervix is not sufficiently dilated, when mother and child are in good condition, and when there are no indications for immediate extraction, the patient may be allowed to pass out of anesthesia, and the uterus may be expected to expel its contents with its ordinary promptness.

FIG. 286.—Frozen section of a patient who died of rupture of the uterus (Zweifel): the anterior leg is partly delivered, the trunk fills the pelvic cavity snugly, and the arms and head are located in the elongated uterus high in the mother's abdomen.

Extraction.—In the section on breech delivery (Vol. I., p. 520) will be found a full description of the different methods of extracting the child when once the child's breech has been brought within the cervix. After a troublesome version, and in any case where much traction on the breech has been required, the arms are likely to be found in the most difficult position to extract—namely, above the head. The frozen section (Fig. 286) of a patient who died with a ruptured uterus shows the disturbed relations of the arms.

In the ordinary method of extraction the trunk is carried sharply to one side, the posterior shoulder is brought as nearly as possible into the sacral hol-

low, and the hands are slipped along the back of this posterior shoulder until the operator's finger-tip can reach up near the elbow to swing the arm across the chest of the child. This manipulation, as will be seen in Figure 287, is effective when the elbow can be brought below the inlet, and, as a rule, only then. It is the procedure usually advised in text-books. The writer succeeded in unlocking some very difficult cases by the method advised by Barnes. He swings the rear shoulder well backward, passes that hand whose

FIG. 287.—The usual method of swinging an extended arm across the child's chest to extract it.

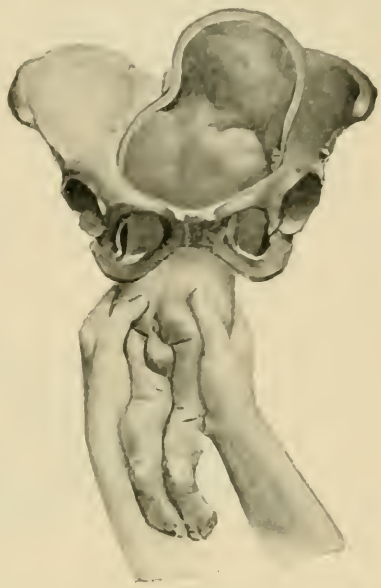


FIG. 288.—Rotation of the trunk to bring one shoulder toward the sacrum.

palm most conveniently lies against the child's back, forward under the pubic arch into the vulva, along the child's back and shoulder, following down the

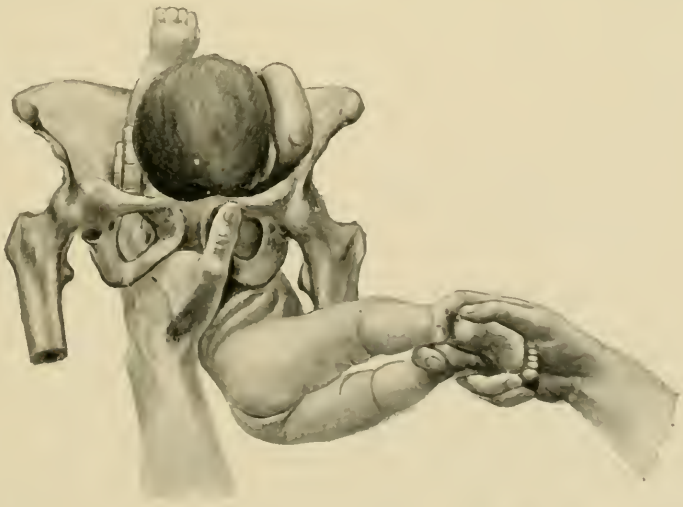


FIG. 289.—The hand passed in under the pubic arch along the arm sweeps the elbow across the child's face (not on the same scale as the preceding).

humerus as near to the elbow as possible (Fig. 289). Pressure with the finger-tips now swings the elbow across the face in front of the promontory and toward

the upper chest of the child. The writer slips in the other hand along the child's abdomen to extract the arm. The hands are then applied flatly against the sides of the trunk and the body is rotated in order to bring the other shoulder toward the promontory (Fig. 288). This maneuvre is repeated on the remaining arm, the operator using the other hand; but usually a deadlock is caused by the jamming of the elbow of the child between its face and the

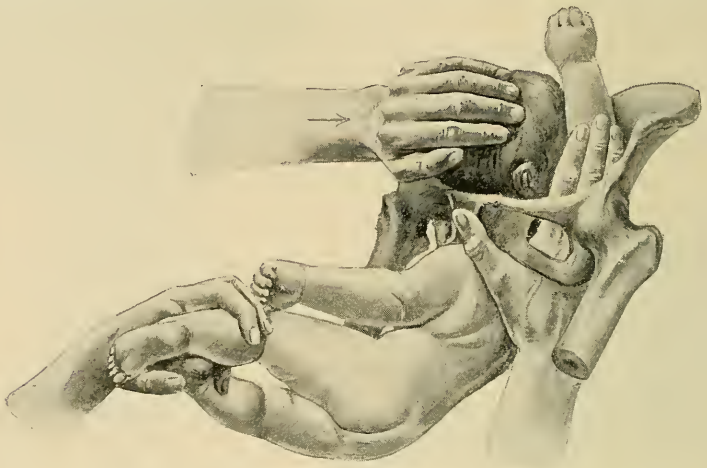


FIG. 290.—To enable the elbow to pass over the promontory the face must get out of the way. The left hand of the operator therefore rotates the head to free the elbow.

promontory. This difficulty may be overcome by firm pressure with the inner fingers at the same time that the outer hand seizes the occiput (Fig. 290), shoving the latter in the opposite direction from that in which the inner fingers are pushing. This manipulation causes rotation of the head and an excursion of the forehead in the direction in which the elbow is attempting to move; besides, there is an appreciable diminution of the resistance to the flexing of the arm.

Should this maneuvre fail, the child must be rotated through three-quarters of a circle, so that the arm shall be left behind, as it were, as the body is swept around, thus bringing the arm across the chest. A deep reach will secure the elbow. One must expect, in this procedure, to have the child run considerable risk, on account of the dangerous torsion to which the neck is subjected if the head does not freely follow the body-rotation.

It is claimed that an additional length of true conjugate can be obtained by the Walcher posture, whereby the thighs are drawn as far backward as possible, the patient lying on the edge of the table or the bed (Fig. 299).

Neglected or Impacted Cases.—Considerable judgment will be required in determining how far we dare proceed, and much tact must be exercised in our manipulations, in cases where the uterus has fitted itself firmly about the child. A uterine wall in apparently tonic spasm will sometimes relax. The knee-chest posture or anesthesia to the surgical degree with the patient in the lateral or the Trendelenburg posture is necessary to secure the utmost relaxation.

The feet of the child are drawn down while its head is pushed up by one of the methods previously described. In case of failure, or in those cases where impaction of a dead child with permanent contraction of the uterus renders further attempts dangerous to the mother's life, embryotomy is in order. Decapitation is the easiest procedure. Symphysiotomy or Cesarean section may be considered where the pelvis is narrow and the child is living.

The Posture of the Patient in Obstetric Operations.*

There is a definite and practical value to the obstetrician in the knowledge of the mechanical effects that are produced on the pelvis by different postures of the parturient on the birth-canal as a whole.

1. Posture will notably alter the shape of the pelvis in late pregnancy.

2. Increase of the available room in the *entire* pelvic cavity cannot be brought about, since a posture which lengthens the conjugate of the inlet shortens the conjugate of the outlet, and *vice versâ*.

3. To obtain the longest conjugate at the inlet the hanging dorsal posture is to be employed. The gain is nearly 1 cm. ($\frac{1}{3}$ of an inch).

4. To obtain the longest conjugate at the bony outlet the full-flexed dorsal posture is necessary. The increase promises to be from 1.5 to 2 cm. ($\frac{3}{4}$ of an inch).

5. To obtain the straightest birth-canal, the arched dorsal and the full-flexed dorsal postures are desirable.

6. To give freest access to the interior of the fundus of the uterus, postures are desirable in this order—arched dorsal, lateral, full-flexed dorsal.

The various postures are these:

1. *Straight Dorsal Posture.*—Full length on the back, with the legs

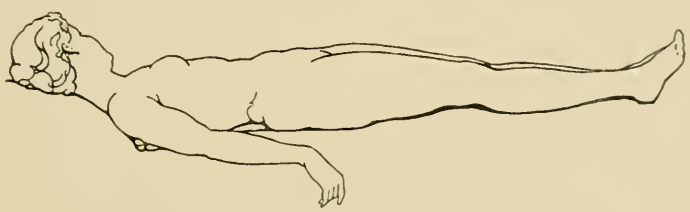


Fig. 291.—Straight dorsal posture. Note the lumbar arching.

extended. Employed in abdominal palpation and external pelvimetry (Figs. 291 and 296).

2. *Flexed Dorsal Posture.*—On the back, the buttocks either at the edge of the table or bed, or about 25 cm. (10 inches) away, the feet on the edge. Employed in vagino-abdominal examination, internal pelvimetry, catheterization, the perineal stage of labor, to relax the pelvic floor in the perineal stage of forceps extraction; in external version; bipolar version; manual dilatation of the cervix (Figs. 292 and 297).

* The full literature to date is given in the *Amer. Jour. Obstetrics*, Dec., 1898, and June, 1899; articles by R. L. Dickinson.

3. *Full-flexed Dorsal Posture.*—On the back, the hip-joints and knee-joints strongly flexed, the knees as near the shoulder as feasible. Employed

Fig. 292.—Flexed dorsal posture—feet on table.

to enlarge the outlet of the bony pelvis for midway and low forceps operations; for internal version; for operations on the cervix and perineum;

Fig. 293.—Full-flexed dorsal posture—knees toward shoulders.

and for curetting. Either of the two latter has been called the lithotomy posture (Figs. 293 and 298).

4. *Hanging Dorsal or Walcher Posture.*—On the back, the lower end of the sacrum on the edge of the table, with or without a cushion beneath

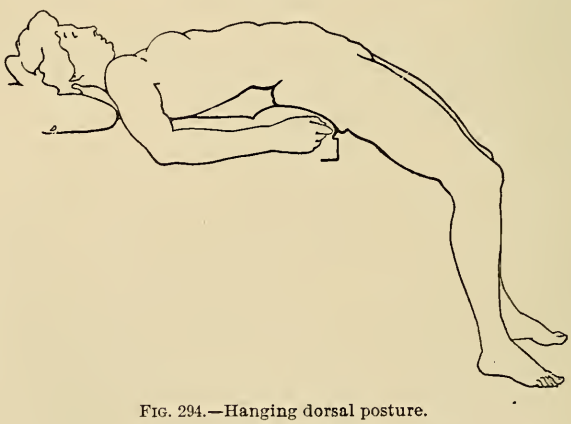


Fig. 294.—Hanging dorsal posture.

it; the lower limbs hanging downward without support. Employed to enlarge the anteroposterior diameter of the inlet for high forceps operation or for extraction of the after-coming head (Figs. 294 and 299).

5. *Inclined Dorsal or Trendelenburg Posture.*—On the back, on an incline, the downward slope from knee (or heel) to shoulder. Employed to make the intestines gravitate from the pelvic cavity toward the upper part of the abdominal cavity. In laparotomy for ectopic gestation, reposition of prolapsed cord, Cesarean section (Fig. 305).

6. *Arched Dorsal or Mercurio Posture.*—On the back, the pelvis higher than the shoulders or knees (being a combination of the inclined dorsal and the hanging dorsal), the sacrum resting on the apex of the slope of the operating-table or on the back of the seat of a tilted chair on its face, the lower limbs swinging clear. Employed for high forceps extraction where

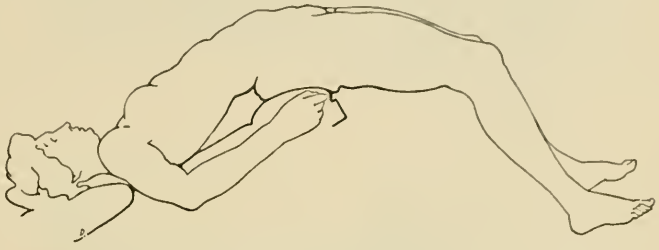


FIG. 295.—Arched dorsal posture.

an enlarged inlet is needed; for internal version where a straight canal and accessible fundus and relaxed uterus are desired; for reposition of the cord (Figs. 295 and 300).

7. *Lateroprone or Sims' Posture.*—On the left side, the left arm behind the patient's back, the face and right shoulder and right knee near one side of a table, the buttocks just overhanging the other side, at a point about 15 cm. (6 inches) from the lower end of table, the right knee on the table. Employed for tamponing the vagina and cervix; for internal version at times.

8. *The Knee-chest Posture* (Campbell's).—Kneeling on the bed with the knees a little separated, with thighs perpendicular, with chest on the bed, arms spread apart, and face turned to one side. Employed for tamponing the vagina and cervix; for reposition of the cord; for placing a bag within the cervix; or passing the bougie; for reposition of the retroverted uterus in early pregnancy or the puerperium.

9. *Half-sitting Posture.*—On the front edge of a chair, leaning backward. Employed for internal ballottement; in bed or on chair during labor, to strengthen the downward pressure.

10. *Squatting Posture.*—The thighs are applied laterally to the abdominal walls. Employed to make pressure on the poles of the ovoid in transverse presentations.

Inclination of the Pelvis; the Horizo-conjugate Angle; Contour of the Birth-canal.—With the patient in the upright position, the angle between the true conjugate and the horizon is between 55° and 60°. The degree of pelvic inclination in the upright position not only differs in individuals, but is also affected by the relative position of the lower limbs. With the

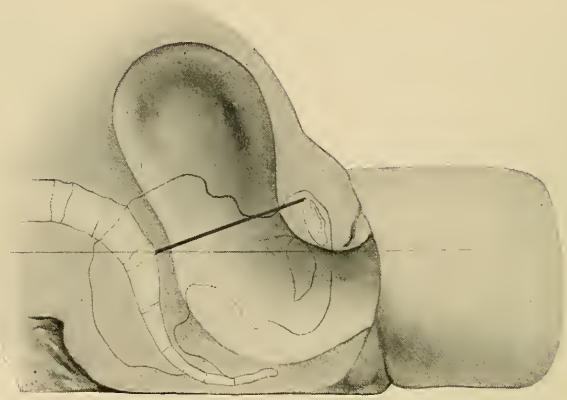


FIG. 296.—Straight dorsal posture with extended thighs. The black line indicates the conjugate of the inlet. The birth-canal is shown in nearly full dilatation.

FIG. 297.—Flexed dorsal posture—feet on table. The angle between plane of inlet and horizon is enlarging, as compared with Fig. 296, and the uterine cavity is more accessible.

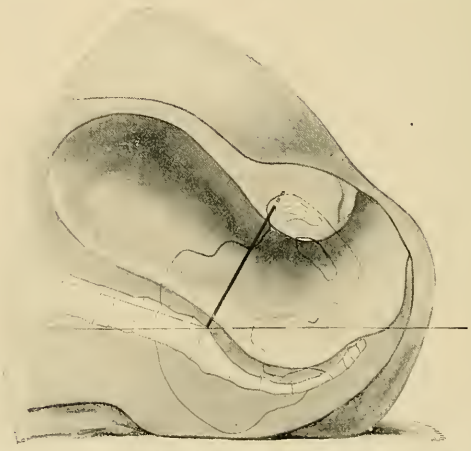


FIG. 298.—Full-flexed dorsal posture. Increased angle between inlet and horizon. Accessible birth-canal, but conjugate of brim shortened 1 cm.

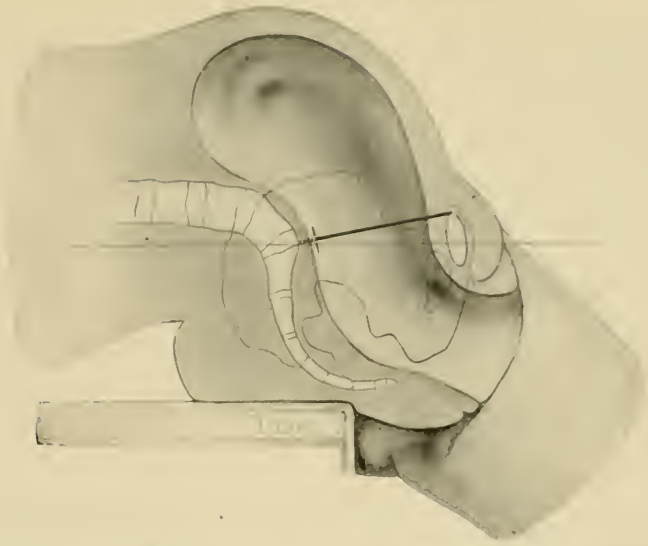


FIG. 299.—The hanging dorsal or Walcher posture. Lengthening of the conjugate of the brim.

FIG. 300.—The arched dorsal or combined Trendelenburg-Walcher posture.

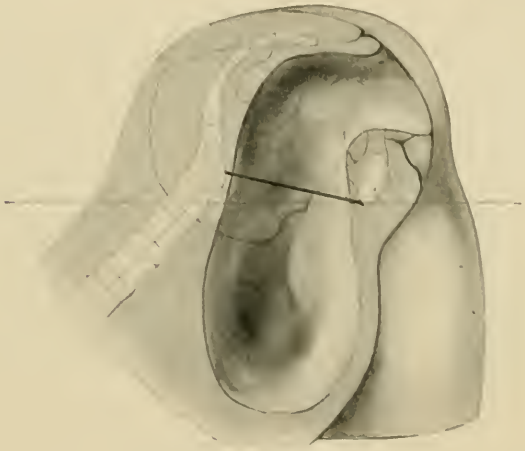


FIG. 301.—Knee-chest posture.

knees touching, or during marked abduction and out-rotation, there is increase of pelvic inclination; it is at its least during moderate abduction and slight in-rotation. "The size of the angle between the conjugate and horizon may be of diagnostic importance in drawing our attention to certain pelvic anomalies. Moreover, an alteration in the axis of the uterus and of the fetus often depends on the altered direction of the plane of the inlet."

It is also to be noted that all these relations change by very simple alterations of position, and therefore the influence of pelvic inclination on the course of labor is distinctly lessened. It was formerly overestimated. But it is of practical value to the obstetrician to understand clearly how the direction of the plane of the inlet is altered by various positions of the body and by what methods these may be influenced.

Straight Dorsal Posture.—The angle of the plane of the inlet to the horizon is 30°. The lumbar curve is very marked.

Flexed Dorsal Posture.—With the knees strongly flexed and the heels close to the buttocks and the knees drawn moderately far apart, the angle between the true conjugate and the horizon in front, or beneath, is 40°.

The vagina from hymen to fornix will trend downward, being nearly at a right angle with the long axis of the uterus; but depression of the perineum by the introduction of the hand will give an angle between the lower part of the birth-canal and the upper part of the birth-canal of about 120°. The abdominal walls will be relaxed.

Flexed Dorsal Posture.—The knees are carried as near to the shoulders as possible. The angle between the conjugate and the horizon beneath will be about 60° with the knees wide apart. The symphysis is driven nearer to the promontory, the iliac bones swing on their rear joints, reversing the conditions shown in Fig. 299. The depressed posterior vaginal wall will fall more nearly into line with the posterior wall of the upper part of the birth-canal, the angle being wider than a right angle. There will be some lateral pressure on the uterus, but in front the abdominal walls will be fairly relaxed. For ordinary delivery under anesthesia, after the head has passed the brim, this is the most available position and measurably straightens the birth-canal. In operations on the perineum and cervix nothing better has been devised.

The Hanging Dorsal or Walcher Posture.—The buttocks are brought to the edge of the table or bed, the legs allowed to hang over, bending backward at the hip-joint as far as possible. The lower end of the sacrum must be at the table's edge. A pillow is placed beneath the sacrum. In this position the plane of the pelvic inlet comes quite close to the horizon, with an average angle of 10° to 15°. The depressed posterior vaginal wall comes nearly in line with the posterior uterine wall, and we have a birth-canal which is as straight a cylinder as it ever can be, while at the same time the conjugate of the brim is lengthened on an average 0.9 cm. ($\frac{3}{8}$ of an inch). There will be some tension on the abdominal walls, so that manipulation through them is not so easy as in other positions.

The objection to this posture is that the direction of traction is straight toward the floor, and the operator must work from below.*

Effect of Posture on the Diameters of the Pelvis.—The transverse diameters are not affected by posture. The conjugate of the inlet is lengthened by the hanging dorsal posture, shortened by the full-flexed dorsal posture. The reverse is true of the outlet. There is much more alteration obtainable by posture on the outlet diameter than on the inlet diameter. When we speak of a gain of a scant centimeter from the hanging dorsal posture, the comparison is made between this posture and the full-flexed dorsal, not between it and the straight dorsal; but this is fair, because the usual attitude for high forceps extraction or delivery of the after-coming head has been heretofore the flexed or full-flexed one. The gain is greater in flat-

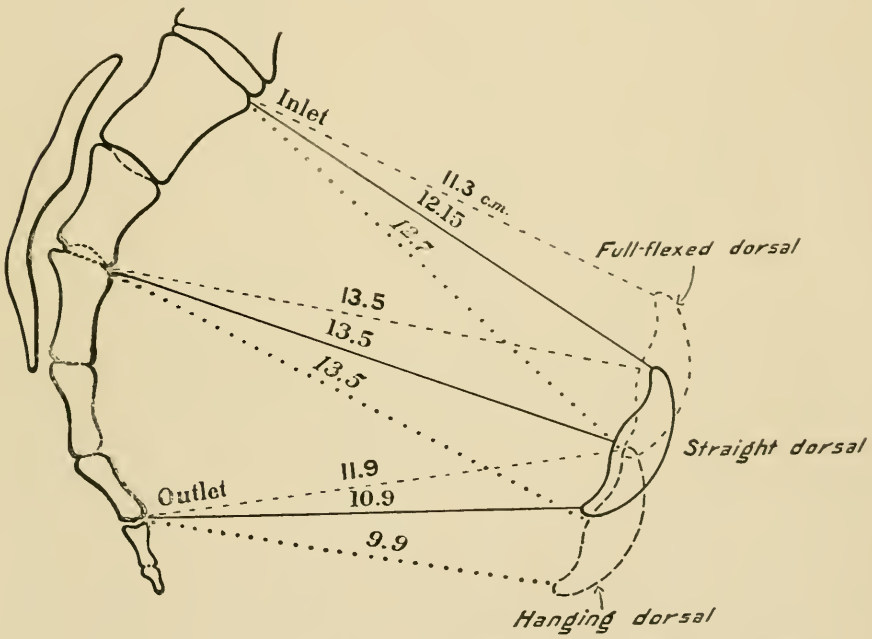


FIG 302.—Pulling down of symphysis and longer vera in hanging dorsal posture (Küttner).

tened pelves than in normal pelves. The gain is far greater in women at term than on the cadaver of the non-puerperal woman. The changes in the sacro-iliac joints during pregnancy permit the weight of the legs (24 to 30 kilograms—33 pounds) to swing the iliac bones on a pivotal point which is located 1 cm. to the rear of the middle of the second sacral vertebra. Taking the sacrum as a fixed point, the symphysis may be said to wander up and down, as shown in the diagram (Fig. 302). One centimeter of motion on the part of the symphysis affects the vera 3 mm. It is said that in flat pelves down to 7 cm. and in generally contracted pelves down to 7.5 cm., spontaneous labors in vertex presentations are rendered possible. Here should be

* The history of this posture, the controversies and literature are given fully in *Amer. Jour. Obstetrics*, June, 1899.

placed also normal pelves with abnormally large children. Even in greater relative disproportion where spontaneous delivery is not to be expected operative procedures are rendered easier and the child's chances bettered. Coincident with this alteration in the relative location of the symphysis, rotation of the symphysis takes place about a transverse axis passing through its middle portion. Thereby, as the symphysis rises, its upper edge approaches the promontory, whereas the lower border goes further and further away from the sacrum (Fig. 302). Conversely, if the legs hang down, the upper edge

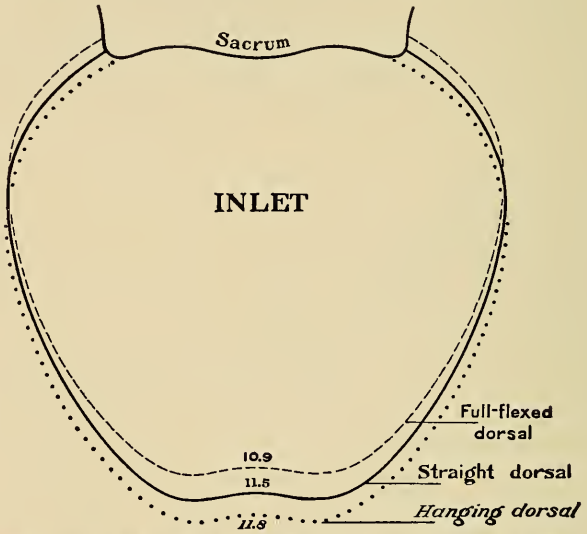


FIG. 303.—The inlet in the three postures—smallest in full-flexed dorsal, longest in hanging dorsal (Küttner).

increases its distance from the promontory, while the lower border approaches the sacrum.

The Arched Dorsal Posture, Trendelenburg-Walcher, or Mercurio Posture.—In delivery in a maternity the patient is placed on the Trendelenburg incline and slid upward till she balances on her sacrum, the legs hanging over. In private practice the patient is readily prepared in the following manner: A plain wooden chair which has a flat back and no rungs between the rear legs is selected, or one steps on the back rung and breaks it out. The chair is then placed on its face across the foot of the bed, the back forming the incline for the Trendelenburg position. A blanket or double sheet is laid along the chair back and may fall over the chair bottom. If it is at hand, a Kelly pad may be placed at the angle of the junction of chair back and chair seat. A sheet is then rolled on the bias to form a loose, long rope, and an end of the rope is tied to one upturned rear chair leg at its injunction with the chair seat. After anesthesia is complete and the patient across the bed, she is rolled onto the chair. Care is taken that the buttocks rest on the upturned back edge of the chair seat, and that they project a little beyond the chair seat toward the operator, so as to give him unim-

peded access to the introitus between the chair's rear legs. The loose end of the sheet is passed behind the patient's neck and in front of the shoulders; then one draws out all the slack and makes fast this free end to the rear leg of the chair on the opposite side (Fig. 305). Now each knee is grasped and the legs swung outward until the thighs hang outside of the upturned chair

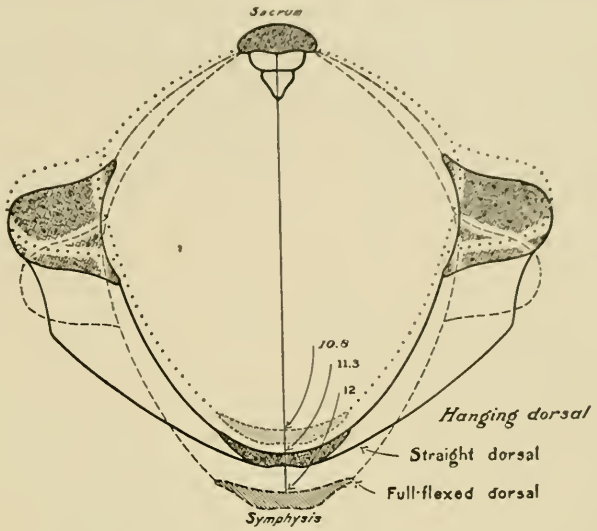


FIG. 304.—The outlet in the three postures—longest in the full-flexed dorsal (Küttner).

legs. Last of all, the chair is lifted so that the front rests at the edge of the bed. The weight of the lower limbs causes them to drop toward the floor with the knee lower than the hip. Should the chair be too wide to give the complete Walcher position with marked extension at the hip-joint, a rolled sheet or other pad is slid up under the sacrum. The patient is now

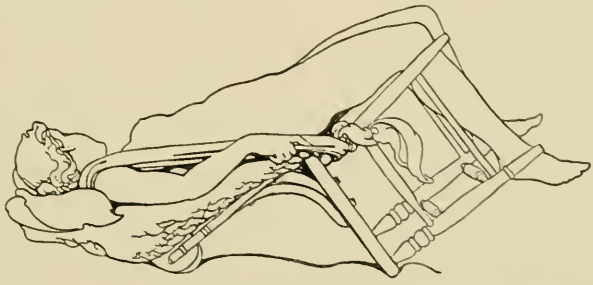


FIG. 305.—The inclined dorsal or Trendelenburg posture with a sheet-sling applied to prevent the patient from slipping. Improvised on a chair turned upside down on its face.

firmly fixed in a position very advantageous for any operative procedure, especially for such as require a relaxed uterus; the vulva is at a convenient height for the standing operator; the direction of the canal formed by the vagina and the cervix, which leads into the uterine cavity, is more direct and more nearly level than that in any other posture. Anesthesia is allowable.

III. Celiotomy for Sepsis in the Child-bearing Period.

Since the first performance by Tait of abdominal section for purulent peritonitis there has been an extremely important development, especially in the last decade, in the scope of pelvic and abdominal surgery for septic inflammations during the child-bearing period.

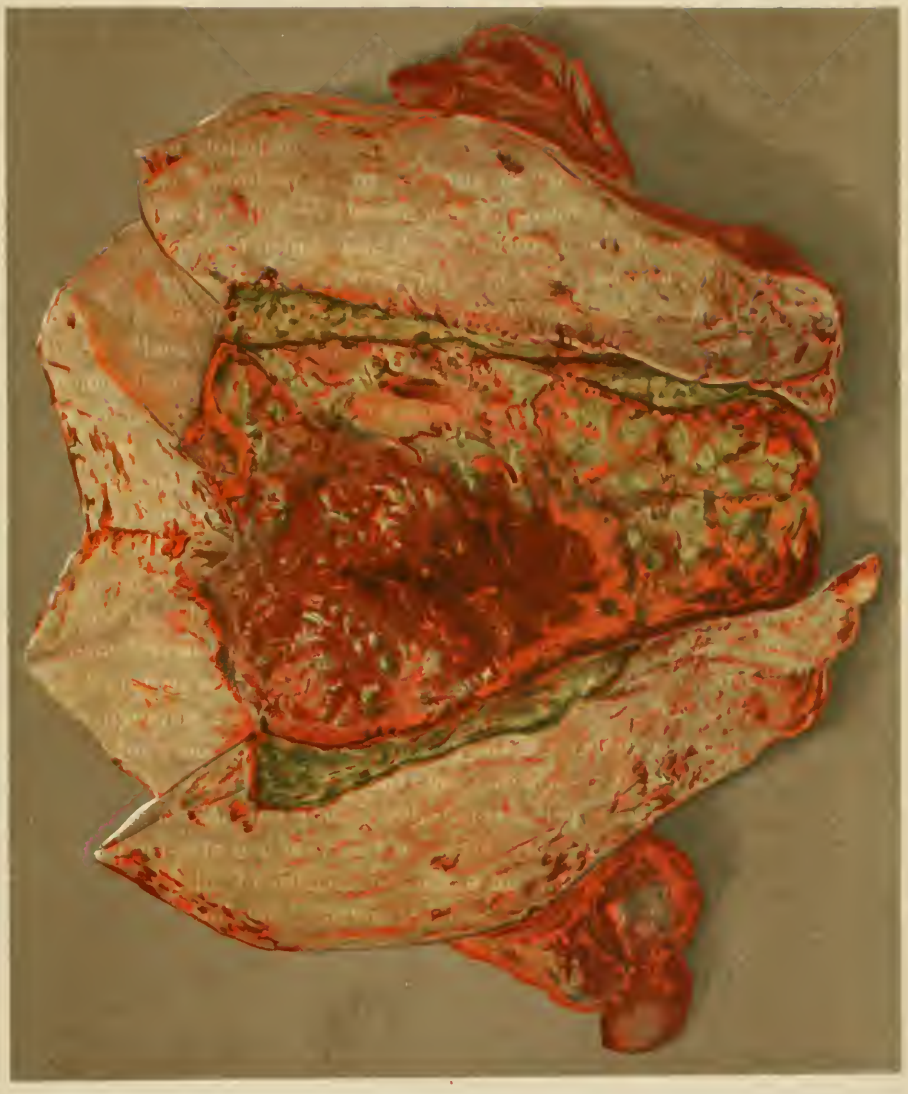
Regarded at first as a procedure analogous to opening an abscess anywhere on the body, the whole abdominal cavity being looked upon as an abscess-cavity and the abdominal walls as its capsule, abdominal section for puerperal sepsis has become a generic term of wide significance, including hysterectomy, salpingo-oöphorectomy, evacuation of abscesses in the peritoneal cavity and in the pelvic connective tissue, removal of gangrenous or infected neoplasms of or in the neighborhood of the parturient tract, and exploratory incisions.

Indications for Abdominal Section in the Treatment of Puerperal Sepsis.—It is more convenient to deal generically with the indications for abdominal section in the course of puerperal sepsis, for the operation is usually decided upon in practice without reference to what may be required after the abdomen is opened, the prudent and experienced obstetrician holding himself in readiness to perform any of the pelvic or abdominal operations detailed above that may be found necessary when the abdominal cavity is exposed to view and to touch.

In order properly to decide the extremely important and anxious question for or against celiotomy in the course of puerperal septic fever, the medical attendant must be familiar with the different forms of sepsis after labor, and should know which of them are most, which are least, amenable to surgical treatment. In a general way it may be stated that the operation is demanded most frequently for localized suppurative peritonitis; it may be indicated, and often is, for diffuse suppurative peritonitis; for suppurative salpingitis and ovaritis; for suppurative metritis, if the inflammation extends outward toward the peritoneal investment of the womb or into the connective tissue of the broad ligament; for abscesses in the pelvic connective tissue; for infected abdominal or pelvic tumors. On the contrary, abdominal section is contra-indicated or is not required in simple sapremia; in septic endometritis of all forms—diphtheritic,* ulcerative, suppurative; in dissecting metritis, sloughing intra-uterine myomata, or in suppurative metritis with the abscess pointing into the uterine cavity; in phlebitis, lymphangitis, and in direct infection of the blood-current. One is most likely to perform an unnecessary operation in diphtheritic endometritis (Pl. 49). The writer has thus erred several times. By the time that symptoms justify surgical intervention in this condition it is always too late.

It is extremely difficult to lay down correct rules for the guidance of a physician in any situation involving so much responsibility, and of necessity so dependent upon many circumstances, as that seeming to require a very serious surgical operation in the midst of an adynamic fever with, very likely, pro-

* By diphtheritic endometritis is meant a dirty, grayish- or greenish-brown exudate on the endometrium, containing mixed micro-organisms, and not necessarily the Klebs-Loeffler bacillus (see Pl. 49).



Diphtheritic endometritis; hysterectomy (Hirst).

found depression, rapid pulse, high temperature—in short, with everything a surgeon least desires in the face of a major operation.

First and foremost, then, the attendant should avoid the operative treatment of puerperal sepsis if possible, and should not seek an excuse for surgical intervention merely in the cardinal symptoms of septic infection—high temperature, rapid pulse, and general depression. He should demand some tangible evidence of those forms of sepsis that are amenable to surgical treatment. But the physician of to-day, while reluctant to operate upon a patient under the least favorable circumstances and on his guard against unnecessary or harmful surgery, must be prepared in the event of certain symptoms or complications to operate with the least possible delay.

Thus, on the very first appearance of symptoms that will justify the diagnosis of diffuse suppurative peritonitis, the abdomen must be opened without a moment's more delay than is necessary for an aseptic operation. Even with the utmost promptness the operation will almost always be too late, for the inflammation extends so rapidly and at first insidiously that by the time a diagnosis is possible the progress of the disease cannot be stayed. The writer must admit, however, contrary to his former belief and declaration, that an occasional success is possible by timely surgical interference.*

Again, in the presence of exudate, adhesions, or unnatural enlargement of any pelvic structure, suppuration may be suspected if the physical signs do not improve and if the temperature, pulse, and general condition indicate a continuance of septic inflammation. It is hardly necessary to state that if pus forms it must be reached and evacuated irrespective of its situation. Just how long to wait, however, is a question requiring experience, good judgment, and a special study of each individual case for its correct answer.

Enormous pelvic and abdominal exudates may disappear; adhesions may melt away; enlarged and inflamed tubes, ovaries, and uterus may resume their proper size, functions, and condition on the subsidence of the inflammation; but in these favorable cases distinct signs of improvement manifest themselves in a few days, and the course of the disease is comparatively short. A mere protraction of septic symptoms is in itself suspicious, *along with local signs of inflammation*. Without the latter, the same general symptoms, sometimes lasting for months, mean phlebitis and infection of the blood-current. In this form of sepsis an operation can do no good and may do the greatest harm.

In infected tumors in and near the genital tract the indication for operation should be plain and the decision easy. The presence of the tumor should of course be known. On the first sign of inflammation in it, or in the event of an elevated temperature for which there is no good explanation, the tumor should be removed. Early operations in these cases have furnished the best results, delayed operations the reverse.† In cystic tumors the likelihood of

* Hirst: "A diffuse, unlimited suppurative peritonitis in a child bearing woman cured by abdominal section"; *Medical News*, 1894. A unique case, in the writer's experience.

† The most desperate cases, however, need not be despaired of. The writer successfully removed a gangrenous ovarian cyst from a puerpera who was so weak that complete anesthesia was not attempted. The late Dr. Goodell had declined the operation as necessarily fatal.

twisted pedicle should be remembered, and in every case of childbirth complicated by a new growth the woman should be watched with extraordinary care to detect the first indication of trouble.

An exploratory abdominal incision should be made, as a rule, only when it is desired to determine if a pelvic mass, presumably containing pus, is situated within or without the peritoneal cavity, and if the abscess had better be evacuated through the abdominal cavity or extra-peritoneally. The writer, in the early period of experimentation with abdominal section for puerperal sepsis, made exploratory incisions in obscure cases without any local symptoms of inflammation in the pelvis or the abdomen, and he has seen a number of such operations in the hands of others. None of these operations yielded information of value, nor did they benefit the patients. Consequently, he adheres to the general rule not to open the abdomen of a puerpera for sepsis unless there are physical signs of inflammation in the abdomen or the pelvis.

Following these general statements in regard to abdominal section for puerperal sepsis, it is now more convenient to describe in detail the different kinds of operations required for the various forms of intra-abdominal septic inflammations.

Abdominal Section for Intraperitoneal Abscesses and Diffuse Suppurative Peritonitis.—The situation and extent of localized suppuration within the abdominal cavity vary greatly. The writer has seen a quarter of the abdominal cavity filled with pus, the huge abscess-cavity being thoroughly walled off by dense exudate from the rest of the abdominal cavity. A smaller collection of pus about the orifice of the tube is not uncommon. In one case two or three abscesses the size of an orange were found in coils of intestine quite far removed from one another and without apparent connection with the genital tract. In three cases abscesses were found between the fundus uteri and adjoining structures—the abdominal wall near the umbilicus in one, the caput coli in the second, and the sigmoid flexure in the third. In these cases infection had travelled through a sharply-defined area of uterine wall and had appeared in the same limits on its peritoneal investment. Exudate and adhesions immediately walled off the infected area, with the result of an encapsulated abscess between the uterine wall and the structure nearest to it at the time of inflammation. The treatment of these abscesses consists in their thorough evacuation, the cleansing of the cavity, and drainage. The cleansing may be effected by flushing with hot sterilized water, if the rest of the abdominal cavity can be guarded from contamination. In some cases the writer has avoided irrigation and in its place has thoroughly dried the cavities with gauze with good results. For drainage, as a rule, iodoform gauze will usually be found best. In certain cases of abscesses near the abdominal walls a rubber tube answers better than the gauze, and in deep-seated abscesses on the base and the back of broad ligaments vaginal drainage by means of gauze or rubber tube is much to be preferred. If the work during the operation is well done, there may be little or no subsequent discharge, and douching of the abscess-cavities during convalescence is uncalled for. Occasionally, however, if the abscess-cavity is

very large and well isolated, daily douching with sterile hot water is an advantage. In diffuse suppurative peritonitis the remote chance of success depends greatly upon the earliest possible operation, though there are many virulent cases in which nothing could stop the spread of the inflammation and the deadly effect of septic absorption.

This is not the place to discuss the symptoms of diffuse suppurative peritonitis, but one fact should be insisted upon from the operator's point of view. It is usually supposed that true diffuse suppurative peritonitis appears early after delivery; it may, however, develop at any time. The writer has seen it as late as four weeks after confinement. The woman, who had been up and about for some time, lifted an older child down a few steps. The effort squeezed a few drops of pus out of one of the tubes. The abdomen was opened within twenty hours, but to no purpose. The technique of the operation is simple: A small incision is made, and the finger is rapidly swept about the pelvis and abdomen to determine the condition of the organs; then the irrigating tube is passed into the cavity at the lowest angle of the wound and is swept about in all directions, while the return-flow is provided for by two fingers of the left hand distending the sides of the wound, which by the fingers and the irrigating tube is kept gaping as though by a trivalve speculum. Gauze drainage into the pouch of Douglas and the flanks is provided for, and the wound is left open, or, at most, drawn together by a stitch or two. Rapidity of operation and the smallest possible quantity of anesthetic are essential to success.

Salpingo-oöphorectmy for Puerperal Sepsis.—An acute pyosalpinx in the puerperium is very rare. It is uncommon for acute septic infection after labor to travel by the tubes alone. Infection usually occurs in the uterine muscle, the veins, the lymphatics, or the connective tissue of the pelvis. When the track of the septic inflammation is confined to the mucous membrane of the genital tract, the pelvic peritoneum, in a case serious enough to demand operation during puerperal convalescence, becomes infected, inflamed, and suppuration quickly follows, so that the operation is usually performed for an intraperitoneal pelvic abscess. The tube may be found somewhat swollen, inflamed, and containing a few drops of pus, and its removal is required; but the pyosalpinx is a subordinate feature in the pelvic inflammation. It is the more subacute case, not usually requiring operation in the conventional period of the puerperium, that results later in a typical uncomplicated pus-tube.

Ovarian abscess is more common than pyosalpinx. The writer has seen the infection travel to the ovary, both by the tube and by the connective tissue or lymphatics of the broad ligament. In the latter case the whole ovary may be infiltrated with a thin sero-pus of a particularly virulent character, and, unfortunately, in excising the ovary the exposure of the infected pelvic connective tissue in the stump almost surely leads to infection of the peritoneal cavity and to a diffuse suppurative peritonitis.

The commonest indication for salpingo-oöphorectomy is furnished by a pus-tube antedating conception. The strain of labor excites a fresh outbreak of

inflammation or leads to its spread, and the persistence of septic symptoms with the physical signs of pelvic inflammation justifies operative interference. In one exceedingly instructive case under the writer's charge an operation was performed on a presumptive diagnosis of old pus-tubes, the diagnosis being based mainly upon the patient's history and the existence of serious septic symptoms, with tenderness on abdominal palpation over the region of the tube and ovary. The uterus was much too high in the abdominal cavity to permit of a satisfactory pelvic examination of the uterine appendages. On opening the abdomen a pyosalpinx was found. The patient recovered.

There is nothing peculiar in the technique of these operations. They differ in no respect from similar operations upon non-puerperal patients. The question of removing the uterus along with the tubes will, however, arise rather more frequently than in the non-puerperal woman, on account of the infection of the endometrium or of persistent metrorrhagia.

Hysterectomy for Puerperal Sepsis.—The latest development in celiotomy for puerperal sepsis is the removal of all the pelvic organs and structures that can be removed when the septic inflammation or suppuration involves the uterine muscles and the broad ligaments. Every physician who has seen many cases of puerperal infection during operations or *post-mortem* is aware that there are some in which the mere removal of infected tubes and ovaries or the evacuation of pelvic abscesses cannot be expected to save the patient. There would be left behind areas of infected and infiltrated broad ligaments that would surely communicate infection to the peritoneal cavity, or there would remain foci of suppuration or infection in the uterine body that must surely spread to the peritoneum or must result in septic metastases. The only hope for the patient in such cases lies in the entire removal of all infected areas, leaving behind in the pelvis a healthy, non-infected stump. To effect this result the

FIG. 306.—Hysterectomy for purulent salpingitis (Hirst).

excision of the uterus, the broad ligaments, the tubes, and the ovaries is required. In addition to these cases there are others in which, if the tubes and ovaries must be excised, the uterus might be removed with advantage, on account of an infected endometrium or of persistent metrorrhagia. Figure 306 is an example of such a case. The young woman from whom the specimen was removed had a double pyosalpinx following a criminal abortion. For seven weeks she had been bleeding persistently and at intervals had a foul-smelling discharge. Although the body of the womb was healthy and the

endometrium was alone inflamed and infected, it was obviously wiser to remove at once all source of the trouble rather than to excise the tubes and ovaries and then to treat separately at some trouble and risk an organ that had become entirely superfluous. The result justified the procedure. There may also be such widespread suppuration and disintegration of the broad ligaments, along with tubal inflammation, that the complete removal of all the infected area is more

FIG. 307.—Suppurative cellulitis of broad ligament; hysterectomy (Hirst).

easily accomplished, especially as regards the control of hemorrhage, by a hysterectomy. Figure 307 represents such a case. In this woman a pyosalpinx antedated conception. Labor excited fresh inflammation. The infection spread from the tube downward through the connective tissue of the broad ligament, resulting in a partial destruction of it, in a thick infiltration at its base, and in

FIG. 308.—Suppurative and ulcerative metritis, salpingitis; hysterectomy (Hirst).

an abscess between its layers, closely hugging the whole of one side of the uterine body. It was obviously impossible to remove the infected area here without removing the womb as well. The operation, though undertaken under the most discouraging circumstances, was successful.

There can be no doubt as to the necessity of hysterectomy in such a case as that represented in Figure 308. There were abscesses in the uterine wall directly under the peritoneal envelope about to break into the peritoneal cavity; one, indeed, did rupture during the operation. There was a septic ulceration at the

placenta site so nearly perforating the uterine wall that by a light touch during the operation the forefinger passed into the uterine cavity. There was also a pyosalpinx in this case that, judging by the history, antedated or was coincident with impregnation. The operation saved the patient.

Indications for the Operation.—The indications for hysterectomy during puerperal sepsis are furnished by the condition of the pelvic organs when they are exposed to sight and touch after the abdomen is opened. The three cases described above are the types calling for hysterectomy. It is not often possible to determine upon hysterectomy before the abdomen is opened, but it should be remembered that in any abdominal section for puerperal sepsis hysterectomy may be necessary. The careful obstetric surgeon therefore should be provided

FIG. 309.—Suppurative ovaritis (rear view).

with the implements required for amputation of the womb in every abdominal section for puerperal sepsis, and be prepared to remove the womb for any one of the three indications described above, but content with the least radical measure that promises his patient safety. The operation that is quickest done and shocks the patient least is most successful, provided, of course, that it is adequate.

Technique of the Operation.—There are two points in which the technique of hysterectomy for puerperal sepsis may differ from the technique of the operation performed for other conditions. One of these points is the necessity often of doing pan-hysterectomy; the other is the necessity often of tying the ligatures in a broad ligament much thickened by inflammatory exudate.

The writer's preference is strongly for amputation of the womb, leaving as little cervix as possible, and this he always does unless an examination of the cervix by a speculum shows septic ulceration or exudate upon it or in its canal. The reasons for this preference for amputation of the womb over pan-hysterectomy are that the former can be done more quickly, there is not the same anxiety about the cleanliness of the vagina, and the suture material is more certainly guarded from infection afterward.

The thickened broad ligaments are often a source of serious embarrassment in placing and tying the ligatures around the uterine arteries. The writer had this difficulty to contend with in the majority of the operations he has performed. In two instances the inflammatory exudate within and below the ligature broke down into pus, but in both cases an incision in the posterior vaginal vault evacuated the pus and secured an immediate disappearance of

somewhat alarming symptoms. In one case it was necessary to do this as late as four weeks after the hysterectomy.

Exploratory Abdominal Section for Puerperal Sepsis.—In the writer's opinion, an exploratory incision should be made only in cases of suspected extra-peritoneal pelvic abscess, to confirm one's suspicion, to be certain that none of the pelvic organs, especially the tubes, are diseased, and to determine the best situation for the incision that shall evacuate the abscess-cavity without contaminating the peritoneal cavity. This rule of practice would exclude exploratory abdominal section in those cases in which there are no physical signs of pelvic inflammation, but in which there is evident septic infection of a nature difficult to determine. As stated previously, the writer resorted to this practice formerly, and has seen others do so, but never with benefit to the patients. There are

FIG. 310.—Exploratory abdominal section: incision in groin for extra-peritoneal abscess (Hirst).

possible exceptions to the rule, however, as in the case described on page 507, of suspected pyosalpinx without physical signs, owing to the high position of the recently emptied womb and of its appendages.

Figure 310, drawn from life, represents a typical case requiring exploratory abdominal section. The woman had a miscarriage some weeks before the writer's first visit to her. She had lost over thirty pounds in weight, was bed-ridden, had night-sweats, high fever, profound prostration, and exacerbations of pain in the pelvis. On examination the usual symptoms of extra-peritoneal pelvic exudate and suppuration were found on the right side. When the abdomen was opened it was found that all the pelvic organs and the pelvic peritoneum were perfectly healthy. There was a large collection of pus between the layers of the right broad ligament, giving to this structure a dome-

shape. The tube and ovary running over the top of the distended broad ligament were perfectly healthy and without a trace of adhesion or inflammation of any kind. With the abdomen opened it was easy to locate the level of the anterior duplication of the peritoneum. A mark was made on the skin an inch below this point, the abdominal wound was closed, an incision was made in the groin, as shown in the drawing, and the pus washed out by douching. Sinuous tracts of suppuration were found by the finger running up the psoas muscle and down into the floor of the pelvis. Two drainage-tubes were inserted, one upward into the psoas muscle, the other downward into the pelvis. In the course of this woman's convalescence it was found advisable to make a counter-opening in the right lateral fornix of the vagina and to pass a drainage-tube through from the opening in the groin to the vagina. This established perfect drainage, and the patient made a good recovery.

Cases like this of true extra-peritoneal pelvic abscess due to puerperal infection and without intra-peritoneal inflammation are rare. There are some gynecologists who deny their existence, but the writer has had two cases under his charge in which the diagnosis was established by abdominal section.

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